SustaneTechnologies

PYROLYSIS PLANT

Environmental Assessment Registration

June 2018

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PYROLYSIS PLANT -
Environmental Assessment Registration Document

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June 2018

SustaneTechnologies

June 27, 2018

Environmental Assessment Branch

Nova Scotia Environment

PO Box 442, Halifax, Nova Scotia

B3J 2P8

To Whom It May Concern:

Please find enclosed the Environmental Assessment Registration Document for the Sustane Pyrolysis Project.

The undersigned approves and accepts the contents, as submitted to the Nova Scotia Environment Department, Environmental Assessment Branch. I am also confirming that we have not received any public funding for the development of the Project.

Yours Truly,

Mark Savory, P.Eng.

Project Director/VP Deployment

Sustane Technologies Inc.

EXECUTIVE SUMMARY

Sustane Chester Inc. (Sustane) proposes to construct and operate a Pyrolysis Plant (the Project) within the same building as a demonstration facility for the diversion and recycling of municipal solid waste (MSW). The Project will be located within the Municipality of the District of Chester (MODC), approximately 20 km north of the town of Chester, NS at the existing Kaizer Meadow Environmental Management Centre (KMEMC) (44°43'06.93"N, 64°14'14.94"W), in Sherwood, on a 4.99 ha parcel of land (PID 60704418) registered under the Municipality of the District of Chester and leased by Sustane.

The Project is considered a Class I undertaking under the Nova Scotia Environment Assessment Regulations and as such, requires a registered Environmental Assessment as identified under Schedule A, Sections 'A.8' and 'E.3' of the Regulations. The Environmental Assessment and the registration document have been completed according to the methodologies and requirements outlined in the document "A Proponent's Guide to Environmental Assessment", as well as accepted best practices for conducting environmental assessments.

A number of environmental components were evaluated for this assessment. Based on field data and associated research, mitigation strategies and best management practices were identified to avoid or mitigate potential effects of the Project for the majority of the components. Following the preliminary assessment, the valued ecosystem components determined for further assessment were:

- Atmosphere Environment
- Avifauna

The effects assessment for these components determined that residual effects are expected to be not significant. Cumulative effects were also considered to be not significant.

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LIST OF ACRONYMS

ACCDC	Atlantic Canada Conservation Data Centre
AQHI	Air Quality Health Index
CEAA	*Canadian Environmental Assessment Act*
COMFIT	Community Feed-in Tariff
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EC	Environment Canada
EEMP	Environmental Effects Monitoring Plan
EPP	Environmental Protection Plan
ESCP	Erosion and Sediment Control Plan
IBA	Important Bird Area
MBBA	Maritime Breeding Bird Atlas
MBCA	*Migratory Birds Convention Act*
MODC	Municipality of the District of Chester
MRES	Marine Renewable Energy Strategy
NCG	Non Condensable Gas
NSCCH	Nova Scotia Communities, Culture and Heritage
NSDNR	Nova Scotia Department of Natural Resources
NSDOE	Nova Scotia Department of Energy
NSE	Nova Scotia Environment
NSEA	*Nova Scotia Environment Act*
NSESA	*Nova Scotia Endangered Species Act*
NSPI	Nova Scotia Power Inc.
NSTIR	Nova Scotia Transportation and Infrastructure
PID	Property Identification Number
SARA	*Species at Risk Act*
SOCI	Species of Conservation Interest
VEC	Valued Ecosystem Component
WAM	Wet Areas Mapping
WHMIS	Workplace Hazardous Materials Information System

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1.0 INTRODUCTION

Sustane Chester Inc. (Sustane) proposes to construct and operate a Pyrolysis Plant ("Project") in the same building as a demonstration facility (the Facility) for the diversion and recycling of municipal solid waste (MSW). The Project will be located within the Municipality of the District of Chester (MODC), approximately 20 km north of the town of Chester, NS at the existing Kaizer Meadow Environmental Management Centre (KMEMC) (44°43'06.93"N, 64°14'14.94"W), in Sherwood, on a 4.99 ha parcel of land (PID 60704418) registered under the Municipality of the District of Chester and leased by Sustane. A site location plan is provided as Drawing 1.1.

1.1 Proponent Information

Sustane is a cleantech company focused on waste transformation. They have developed and are commercializing a set of disruptive processes to transform municipal solid waste (MSW) streams into high value fuels and recyclable materials. Their separation technology differs from other approaches that typically extract waste mixtures, by delivering clean products that were not previously possible. The result is unprecedented value recovery and waste diversion levels.

Proponent and consultant contact information is provided in Table 1.1. Registry of joint stocks for the Proponent company is included in Appendix A.

Table 1.1: Proponent Information

PROPONENT	
Name	Sustane Technologies Inc.
Address	Suite 230, 3700 Kempt Road Halifax, NS, B3K 4X8
Telephone	902.932.8870
Website	www.sustanetech.com
Proponent Contact	
Name	Mark Savory
Official Title	Project Director/VP Deployment
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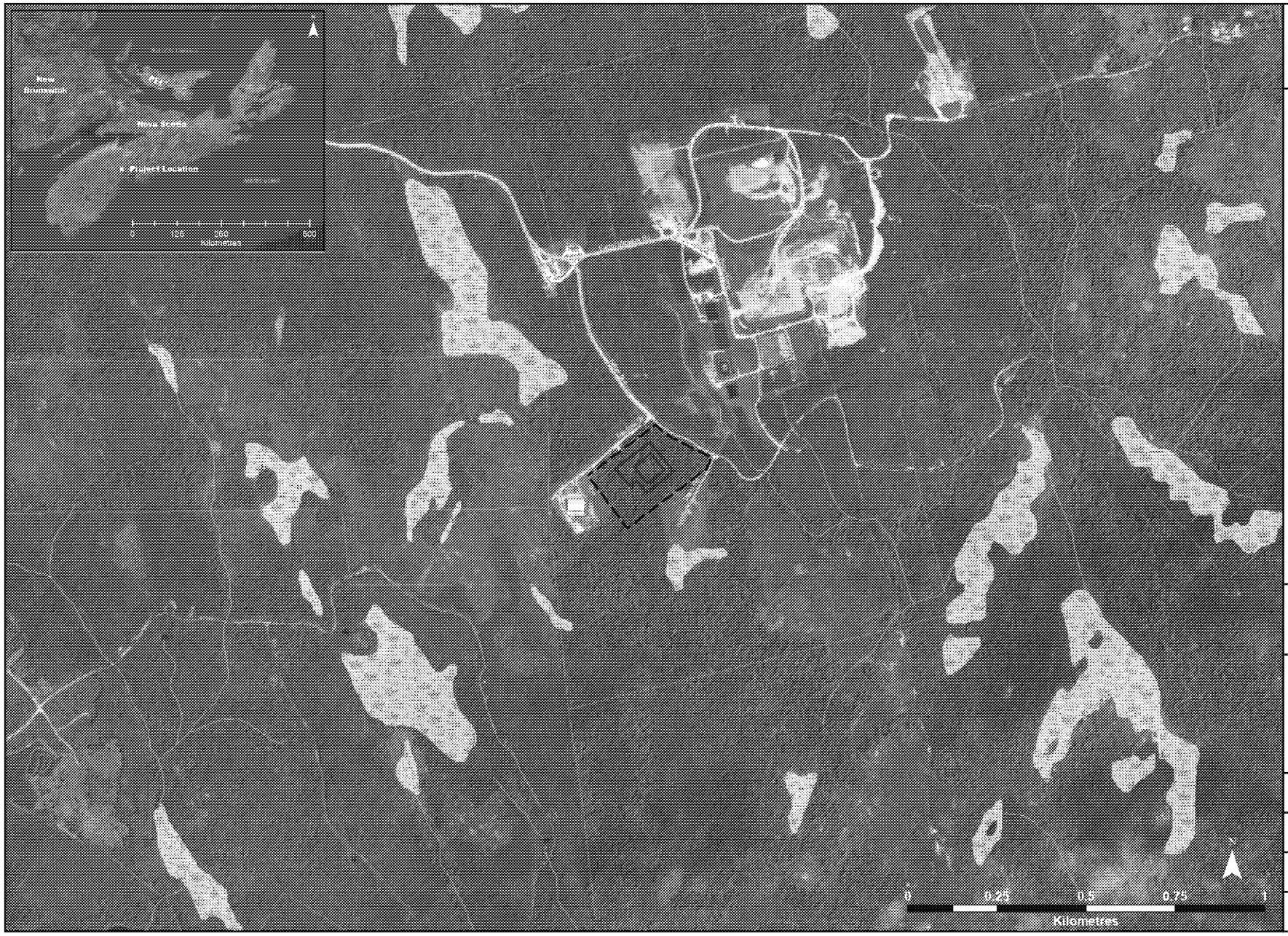
Email	sduncan@strum.com



Notes:

1. Data Sources: GeoNOVA, NSTD, Sustane.
2. Basemap: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
3. Projection: NAD83 UTM Zone 20 North.

Legend:

- PID60704418
- Advanced MSW Recycling Building
- Property Boundaries

Transportation

- Local Road
- Unpaved Road
- Driveway
- Track

Water Features

- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area

Sustane Chester Inc. Pyrolysis Plant - Site Location

Strum Environmental

*Engineering * Surveying * Environmental*
*Bedford * Antigonish * Moncton * Deer Lake*

Date: June 2018	Project #: 18-6355
Scale: 1:10,000	Drawing #: 1.1
Drawn By: M. Marriott	
Checked By: S. Duncan	

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1.2 Project Information

Name of the Undertaking: Pyrolysis Plant ("Project")
Location of the Undertaking: Kaizer Meadow Environmental Management Centre (KMEMC), Sherwood, NS

The project is located at the existing Kaizer Meadow Environmental Management Centre (KMEMC), in Sherwood, NS, within the building designated for the Advanced MSW Recycling Demonstration Facility (The Recycling Project) on PID 60704418.

1.3 Purpose and Need for the Project

The inclusion of the Pyrolysis Plant at the Advanced MSW Recycling Demonstration Facility is an opportunity to solve the problem of plastic waste entering landfills and the environment. The proprietary process recycles plastic back into its basic molecular structure, resulting in a low-sulfur fuel, without the production of toxic emissions.

1.4 Regulatory Framework

1.4.1 Federal

A federal Environmental Assessment (EA) is not required for the Project as it is not located on federal land or listed as a physical activity that constitutes a "designated project" as listed under the Regulations Designating Physical Activities of the *Canadian Environmental Assessment Act* (CEAA) (2012).

The following federal regulations are considered applicable to the Project.

Table 1.2: Potential Federal Approvals

Permit/License/Approval/Notification/Lease Required	Government Agency
Compliance with Migratory Birds Convention Act (MBCA)	Environment Canada
Compliance with Species at Risk Act (SARA)	Environment Canada

1.4.2 Provincial

The Project is subject to a Class I EA as defined by the Nova Scotia Environment Assessment Regulations, requiring a registered EA under Schedule A, Sections 'A.8' and 'E.3' of the Regulations. As such, the Proponent is required to register the Project with Nova Scotia Environment (NSE) and subsequently comply with the Class 1 registration process as defined by the document "A Proponent's Guide to Environmental Assessment" (NSE 2017).

The following provincial approvals are anticipated for the Project.

Table 1.3: Potential Provincial Approvals

Permit/License/Approval/Notification/Lease Required	Government Agency/Relevant Laws
Review/approval – *Endangered Species Act*	NSDNR
Industrial Operations Approval	NSE

All required provincial permits and approvals will be obtained prior to final commissioning.

1.4.3 Municipal

The proposed Project site is on land owned by the Municipality of the District of Chester (MODC), which is currently on a long term lease to Sustane (refer to Appendix B for the Ground Lease). Sustane has been in direct contact with officials at MODC throughout the development of the Project and will amend their development and building permit for the Advanced MSW Recycling Demonstration Facilities to accommodate the Pyrolysis Plant, if necessary.

1.5 Scope of the EA

An EA is a planning tool used to predict the environmental effects of a proposed Project, identify measures to mitigate adverse environmental effects, and predict whether there will be significant adverse environmental effect after mitigation is implemented. The methodology used in this EA has been developed to meet the requirements of the *NS Environment Act (NSEA).* This framework is based on a structured approach that:

- focuses on issues of greatest concern;
- considers Aboriginal concerns as well as concerns raised by the public and other stakeholders; and
- integrates mitigative measures into Project design.

The EA provides an overview of the baseline conditions and individual Project components. Within the specified spatial and temporal boundaries, potential interactions between the Project and the environment are identified for the determination of Valued Ecosystem Components (VECs) that reflect key issues of concern. Project effects on individual VECs are assessed using the results of preliminary investigations, guidance from regulators, and the collective knowledge and expertise of the Project team. The ultimate focus of the assessment is on residual environmental effects that remain after planned mitigation has been applied.

1.5.1 Spatial and Temporal Boundaries

The spatial boundaries of the Project are contained within the Advanced MSW Recycling Demonstration Facility building; only the emissions from the pyrolysis process are released into the environment.

The temporal boundaries for the Project encompass all Project phases, from construction through operation and decommissioning. Accidents, malfunctions, and unplanned events are addressed separately.

1.5.2 Species of Conservation Interest

Species observed or known to exist within 100 km of the Project site were screened against the criteria outlined in the document "Guide to Addressing Wildlife Species and Habitat in an EA Registration Document" (NSE 2009) to develop a list of priority species (i.e., SOCI), which are individually considered during VEC assessments.

In the context of this document, priority species include those that are:

- Listed under SARA as "Endangered", "Threatened", or "Special Concern";
- Listed by COSEWIC as "Endangered", "Threatened", or "Special Concern";
- Listed under the NSESA as "Endangered", "Threatened" or "Vulnerable";
- Assessed by NSDNR as "1 – At Risk", "2 – May be at Risk", or "3 – Sensitive", or "5 – Undetermined"; or
- Listed by the ACCDC as having a sub nationality rank (S-Rank) of "S1", "S2", or "S3".

2.0 PROJECT DESCRIPTION

2.1 Project Overview

The Project is comprised of various pieces of mechanical equipment which are used in combination to process a plastic feedstock into liquid fuel oils and gaseous hydrocarbons in a manner which minimizes the impact to the environment. This is achieved by diverting plastics from a landfill and then by using a thermal conversion method (pyrolysis, detailed in section 2.4) which minimizes harmful air emissions. The technology provider for the Project is Renewlogy, based out of Salt Lake City, Utah, USA who has developed a small scale thermal pyrolysis process over the past 7 years. The liquid fuels produced will be stored on Site (outside of the Facility) in NSE approved fuel oil storage tanks with approximately 30% of the fuels consumed on Site by both the Project and the Recycling Project. The remainder of the produced fuels will be sold and transported off site by a mobile fuel tank which is properly licensed to do so. No fuel will be sold until a Fuel Oil Wholesale/ Distributor Approval has been issued by NSE.

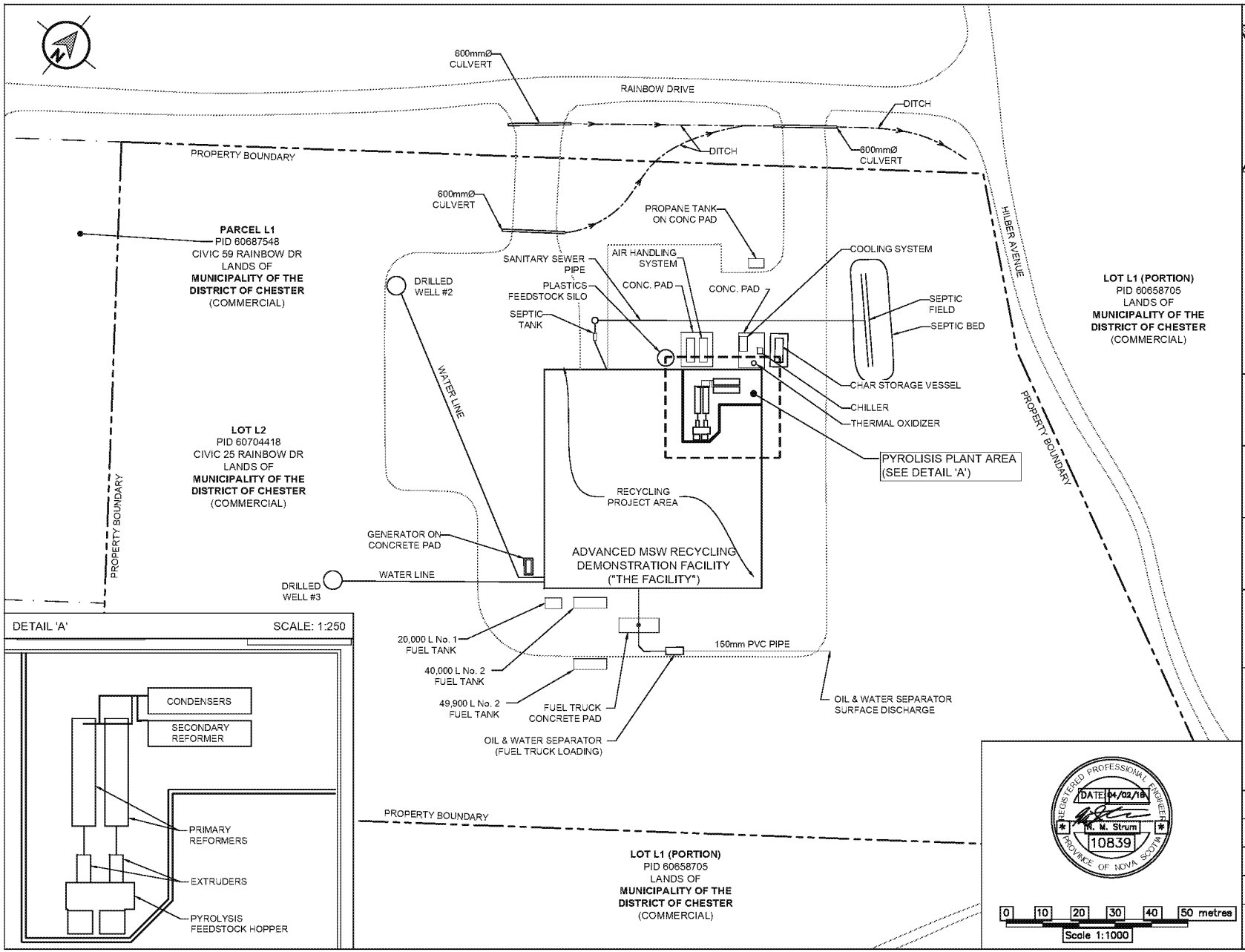
The Project is to be conducted in a dedicated portion of the Facility which is labelled "Pyrolysis Plant Area" on Drawing 2.1 with some components of the Project located on the external wall of the Facility. The Pyrolysis Plant Area is completely enclosed from the remainder of the Facility and has a dedicated air handling system. The remainder of the Facility houses the Recycling Project which is excluded from the scope of this assessment

The Pyrolysis Plant will be a state-of-the-art commercial facility that converts mixed plastic waste into high value fuels. The proprietary process recycles plastic back into its basic molecular structure, resulting in an ultra low-sulfur fuel without the production of toxic emissions. It also solves the problem of plastic waste entering landfills and the environment. Sustane has established a hosting and supply agreement (HSA) with the MODC which allows for sharing of infrastructure and services between the Project and the KMEMC as necessary.

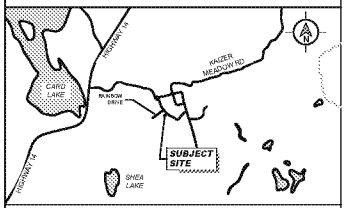
Design details and Project components are described in the following sections.

2.2 Project Location

The Pyrolysis Plant ("Project") will be located within the Advanced MSW Recycling Demonstration Facility building at the existing KMEMC (44°43'06.93"N, 64°14'14.94"W), in Sherwood, Nova Scotia; located approximately 20 km north of the town of Chester. The building is on a 4.99 ha parcel of land (PID 60704418) owned by the Municipality of the District of Chester and leased to Sustane.



KEY PLAN SCALE: NTS



GENERAL NOTES:

1. DRAWING REFERENCES: NOVA SCOTIA PROPERTY RECORDS, DIGITAL TOPOGRAPHIC MAPPING BY NOVA SCOTIA GEOMATICS CENTRE & DRAWINGS 3A-105 & C-001 BY EAST POINT ENGINEERING
2. PROJECTION: NAD83(CSRS), UTM ZONE 20 NORTH.
3. ALL SITE FEATURES AND SERVICES ARE APPROXIMATE.
4. WETLAND AND OTHER WATER FEATURE DELINEATION BASED ON PROVINCIAL 1:10,000 TOPOGRAPHIC MAPPING,

CLIENT:
SUSTANE TECHNOLOGIES INC.

PROJECT:
ENVIRONMENTAL ASSESSMENT

LOCATION:
RAINBOW DRIVE
LUNENBURG COUNTY, NOVA SCOTIA

TITLE:
PYROLISIS PLANT AREA

CONSULTANT:
Strum CONSULTING
Engineering * Surveying * Environmental
Bedford * Antigonish * Deer Lake * Moncton

SCALE: H: 1:1000 V:		
DATE: JUNE 2018		DRAWN: L.PEMBERTON
DESIGNED:	CHECKED: N. STRUM	APPR'D: N. STRUM
PROJECT No.: 18-6355		
DRAWING No.: 2.1		

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2.3 Feed Stock Description

Plastic feedstock for the Project is produced from the Recycling Project. The following sections detail the Recycling Project, plastic feedstock guidelines, initial plastic feedstock testing, and ongoing plastic feedstock testing and plastic feedstock quantities.

2.3.1 Recycling Project Operations

Sustane is constructing and plans to operate a demonstration project for advanced diversion and recycling of MSW which will be located at the Facility. The Recycling Project consists of various mechanical equipment which allow the received MSW to be processed and sorted into separate streams of homogenous materials. Sustane's combination of both conventional and proprietary waste handling equipment produces the separate material streams with very low levels of contamination. The Recycling project occupies the majority of the Facility's footprint and consists of the following components:

- Shredding Area;
- MSW Conditioning Area;
- Drying Area;
- Pelletizer Area; and
- Separation Area.

The Recycling Project will divert MSW which was destined for the KMEMC landfill. The diverted material will be separated into the following valuable material streams:

- Biomass Pellets;
- Ferrous Metals;
- Non Ferrous Metals;
- Polyethylene terephthalate (PET) Plastic;
- Mixed Low Density (LD) Plastics (High-quality stream with low levels of contamination);
- Mixed High Density (HD) plastic (including PVC); and
- Inert solids (glass, sand and grit).

The High-quality, low density plastics stream with low levels of contamination from the Recycling Project constitutes the Plastic feedstock for the Project. The Plastic feedstock is further detailed in the following Sections. Sustane has received approval from NSE for the Recycling Project under Division 3, Part 2 of the ADRs (Approval # 2017-113054-00). This approval application excludes the Recycling Project and its associated works.

2.3.2 Plastic Feedstock Guidelines

Plastic feedstock to the Project will be produced from the Recycling Project. For the Project to function efficiently it is necessary that the plastic feedstock meets the plastic feedstock guidelines which have been defined by the technology supplier (Renewlogy). The plastic feedstock guideline provides general quality guidelines, acceptable plastic feedstock materials, unacceptable plastic feedstock materials and identifies prohibited plastic feedstock materials.

As per the guidelines, Plastic feedstock for the Project must meet the following criteria:

- Maximum plastic feedstock particle size: 6mm flake;
- Total weight of unacceptable materials must not exceed 1%; and
- Plastic feedstock moisture content must not exceed 1%.

Table 2.1 below summarizes plastic feedstock materials which are acceptable, unacceptable and prohibited fort the Project.

Table 2.1: Project Plastic feedstock Guidelines

Acceptable Materials	High-density Polyethylene (HDPE, #2), Low-density Polyethylene (LDPE, #4), Polypropylene (PP, #5), Polystyrene (PS, #6)
Unacceptable Materials	Moisture, Cardboard, Paper, Organics, PET (#1)
Prohibited Materials	Metals, Rubber, Textile, Glass, Aggregate, Silicone based products, Oxidizing agents, Fertilizers, Nitrates, Chlorates, Poisons, Chemicals, Herbicides, Pesticides, Fungicides, Oil based paints, **materials with moderate- to-high levels of nitrogen, chlorine, sulphur or bromine (eg. Polyvinyl Chloride (PVC, #3))**

Sustane is responsible for ensuring that the Plastic feedstock for the Project meets all of the Plastic feedstock guidelines. This will be accomplished by implementing sorting processes in the Recycling Project which are capable of producing a high quality stream of mixed low density plastics with low levels of contamination. Sustane will employ both negative and positive sorting processes, to produce the Plastic feedstock, which are summarized below:

Negative Sorting

- Magnetic separation (remove ferrous metal)
- Trommel Screen (Remove oversize particles)
- Biomass cleaners (remove Biomass, glass, grit)
- Eddy current separator (remove non ferrous metals)
- Optical Separator (removes fabrics, textiles, thin film foil packing and other non plastic contraries)

Positive Sorting

- Flotation Tables; two in series (Separates LD and HD plastics based on specific gravity)
    - The flotation tables separate plastics based on their specific gravity (SG). Plastics with an SG > 1 will sink to the base of the floatation table and be rejected from the plastics feedstock stream. Plastics with SG < 1 will float on the surface of the tables and will be accepted into the Project's Plastic feedstock.
    - The float tables have paddle wheels which submerge the plastics allowing the light plastics to float back to the surface. This reduces the possibility for HD plastics to be accepted into the plastic feedstock.
    - Plastics with an SG>1 are considered HD and plastics with an SG <1 are LD.
    - The following table provides common plastics, their specific gravity and whether they are accepted or rejected from the plastics feedstock.

Table 2.2: Accepted and Rejected materials into the Plastics Feedstock

Accepted into Plastic Feedstock (float)		**Rejected from Plastic Feedstock (Sink)**	
Plastic	Specific Gravity	Plastic	Specific Gravity
HDPE, #2	0.96	PET, #1	1.31
LDPE, #4	0.88	PVC, #3	1.4
PP, #5	0.86		
PS, #6	1.05		
Note: All Specific Gravity values have been provided by Sustane			

By using the sorting processes above, Sustane's Recycling Project will produce a high quality stream of acceptable materials, as listed in Table 2.2, with low levels of contraries (unacceptable and prohibited materials). This stream of material will be used as the plastic feedstock for the Project.

2.3.3 Initial Plastic Feedstock Testing

The Recycling Project is not currently operational and therefore is not able to provide plastic feedstock to the Project. As a result, Sustane has acquired approximately 5 tonnes of initial plastic feedstock which has been derived from MSW sorted in a similar manner to the process detailed in Section 2.3.2. This was completed by the Sustane's Recycling Project technology provider at their test facilities in Salt Lake City, Utah, USA.

Sustane is in the process of conducting analytical testing of the initial plastic feedstock material to confirm that it meets the plastic feedstock guidelines. Testing will consist of a visual inspection and identification of the plastics in the plastic feedstock as well an analytical test to identify the composition of the plastic feedstock. The results of this test will be forwarded to NSE.

If the initial plastic feedstock meets the plastic feedstock guidelines, Sustane will use this plastic feedstock for initial commissioning and operation of the Project. Once the Recycling Project is operational, it will produce the plastic feedstock for the Project. Ongoing monitoring and testing of the plastic feedstock is detailed in section 2.3.4 below.

2.3.4 Ongoing Plastic Feedstock Monitoring and Testing

Once the Recycling Project is operational, it will produce plastic feedstock for the Project. To ensure that the plastic feedstock meets the plastic feedstock guidelines, Sustane will conduct ongoing monitoring and testing of the plastic feedstock. Monitoring and testing will consist of the following:

Table 2.3: Ongoing Plastic Feedstock Monitoring Schedule

Test Program	**Frequency**
Visual inspection in plastics feedstock hopper by operators	Daily
Visual Characterization of 10 kg grab sample (Sustane's onsite lab)	100 Tonnes
Analytical Characterization (3rd Party lab)	1500 Tonnes

A failure in testing will result in re-sorting of material until plastic feedstock meets the guidelines.

2.3.5 Plastic Feedstock Quantities

The Project will process plastic feedstock at a design mass flow rate of 12 tonnes/ day with a maximum mass flow rate of 15 tonnes/ day. If excess plastic feedstock is produced from the Recycling Project, which cannot be processed by the Project, then the excess plastic feedstock will be either transported off site for sale or disposed of at the KMEMC in accordance with the HSA.

2.4 Process Description

The Project is comprised of various pieces of mechanical equipment which are used in combination to process the plastic feedstock (Section 2.3) into liquid fuel oils and gaseous hydrocarbons in a manner which minimizes the impact to the environment. In general, the Project operates as a continuous flow process with certain components run in parallel. The continuous nature of the process allows for more efficient, and complete processing of the plastic feedstock. Certain components are run in parallel to allow for variable residence time in the process as well as system redundancy.

The following sections (2.4.1 through 2.4.12) detail the major structures and components which constitute the Project and are indicate on Drawing 2.1. A process flow and mass balance diagram and a process and instrumentation diagram (P&ID) are detailed in Section 2.4.12.

2.4.1 The Facility and Site Access

The Project is to be conducted at the Facility which is indicated, in relation to ecological receptors, on Drawing 1.1. The Project will occur mainly inside the Facility with the exception of the plastics feedstock silo, the fuel oil storage and handling system and the thermal oxidizer which are further detailed in the following sections. The majority of the components of the Project are in a dedicated area of the Facility which has been labelled, "Pyrolysis Plant Area" and is located in the top right corner of the Drawing 2.1.

Site access for the Facility is shared between the Project and the Recycling Project. MSW is delivered to the site as part of the Recycling Project and is then processed into the Plastic feedstock for the Project. After processing in the Recycling Project, the Plastic feedstock is deposited into the Plastics Feedstock Silo (Section 2.4.2). Fuel produced from the Project is to be stored in the Fuel oil storage system (Section 2.4.10) at the south end of the building. Mobile fuel trucks will access the tanks to take the fuel off site. The Facility and site access are indicated on the Drawing 2.1. Site access routes and parking area are to be gravel surfaces. Storm water drainage features are also indicated on Drawing 2.1.

2.4.2 Plastics Feedstock Silo

The Plastics Feedstock Silo is an 3840 mm diameter, 14,173 mm tall, covered, painted steel silo, mounted on a concrete pad which is located immediately outside of the Facility along the northwest wall as indicated on the Drawing 2.1. The Plastics Feedstock Silo receives and stores the plastic feedstock for the Project which is produced from the Recycling Project. The silo is able to store approximately 50 tonnes of Plastic feedstock. Under normal operations, plastic feedstock from the silo will be transported into the pyrolysis feedstock hopper (Section 2.4.3) for processing. If necessary, excess plastic feedstock from the silo can be deposited directly into a roll on/off bin

located adjacent to the Plastics Feedstock Silo for transport off site (either sale or disposal at KMEMC).

2.4.3 Pyrolysis Feedstock Hopper

The Pyrolysis Feedstock Hopper is a closed top, steel hopper which receives and holds plastic feedstock from the plastics feedstock silo before evenly distributing plastic feedstock into the extruders (Section 2.4.4) as necessary. The Pyrolysis Feedstock Hopper has a maximum capacity of 3 tonnes of Plastic feedstock. Feedstock is supplied to the pyrolysis feedstock hopper on an as needed basis from the Plastics Feedstock Silo and is controlled by an automated signal from the Control System (2.4.11). The pyrolysis feed hopper automatically delivers feed material to the extruders via independently controlled augers

2.4.4 Extruders

There are two Extruders which operate in parallel to receive, soften and condition the Plastic feedstock before transferring it to the Primary Reformers (Section 2.4.5). There are two extruders for redundancy as well as the ability to vary residence time and feed rate of the plastic feedstock into the remainder of the process.

The two extruders are identical in construction and consist of a stainless steel cylinder with electric heaters and insulation along its length. Within the extruder, there is a motorized auger screw which pushes the plastic feedstock through from the Extruder's inlet to its outlet. While in the extruder, the plastic feedstock is heated to 540 ^{o}C which causes it to become a homogenous, liquid mixture. During initial startup, a nitrogen purge is used in the process to remove oxygen from the process. The residence time, and temperature are controlled by the control system to ensure that the plastic feedstock is properly heated.

2.4.5 Primary Reformers

The plastic feedstock is extruded from the Extruders into the two Primary Reformers which operate in parallel. The primary reformers are of similar construction and consist of an enclosed rotating inner stainless steel drum within a fixed steel outer shell. The inner drum is heated by external burners. The outer shell contains the exhaust from the burners and is vented through the Facility ceiling in a dedicated exhaust duct. On initial startup, the primary reformer is fuelled using commercially procured propane. During normal operations, the reformer will be fuelled by non-condensable gas (NCG) produced from the Project which would otherwise be sent to the thermal oxidizer. The composition of the NCG and air emissions from combustion of the NCG are further detailed in Section 2.8.2.

Once the Plastic feedstock enters the Primary Reformers the remainder of the process occurs in an anaerobic atmosphere. While in the Primary reformer, the plastic feedstock undergoes pyrolysis. Pyrolysis is the irreversible, chemical decomposition of a material in a heated, inert atmosphere (e.g. lack of oxygen). Pyrolysis varies from combustion in that combustion requires the presence of oxygen to occur. Combustion also produces Carbon Dioxide and Water, whereas pyrolysis does not.

Pyrolysis causes the long carbon polymer chains in the liquid Plastic feedstock to be broken down into smaller carbon molecules and chains. The smaller carbon chains which result from pyrolysis of

the liquid plastic feedstock are much lighter than the original carbon chains and are converted into a gas (Reformer Gas). The Reformer Gas at this stage is comprised of both condensable, and non-condensable gases which are further detailed in section 2.4.7 and Section 3.8.2 respectively.

The Primary Reformer is a continuous feed process with a variable residence time to account for variations in plastic feedstock composition which may result from variation in the MSW stream. The control system can adjust the primary reformer temperature and residence time in order to allow for the efficient and complete pyrolysis of the plastic feedstock. In this event, the remaining liquid feed stock is transferred from the Primary reformer to the Secondary Reformer (Section 2.4.6). During pyrolysis, some plastic feedstock will be decomposed into a solid char material (further detailed in Section 2.8.3) which will be removed from the reformer.

The Primary Reformer operates at a nominal temperature of 540 °C and a slight negative pressure.

2.4.6 Secondary Reformer

The Secondary Reformer is similar in construction, sizing and function to the Primary Reformers. The Secondary Reformer is located in series after the two parallel Primary Reformers. Liquid plastic feedstock, which was not decomposed into a gas during the Primary Reformer, along with any char are introduced into the Secondary Reformer from the Primary Reformers. The remaining plastic feedstock undergoes additional pyrolysis until all of the liquid has been converted into a gas or decomposed into a solid char. The Reformer Gas produced is directed to the Condenser and heavy gas being reintroduced into the Secondary Reformer for additional pyrolysis.

Liquid Plastic feedstock remains in the Secondary Reformer until it has been completely converted into gas or decomposed into char.

The Secondary Reformer operates at a nominal temperature of 540°C and a slight negative pressure.

2.4.7 Condenser

The Condenser is a process component which is widely used in the production of hydrocarbon fuels. The Condenser receives the Reformer Gas after undergoing pyrolysis in the Primary and Secondary Reformers. The condenser has multiple condensing stages which allow for the separation of fuels based on different densities. The condensers operate in in series and the lighter gas fractions which are not condensed in a given condenser pass through to the next condensing stage.

Multiple condensing stages allows for the production of liquid No. 2 fuel oil (i.e. Diesel) and liquid no. 1 fuel oil (i.e. gasoline, naphtha). The liquid fuels produced are then pumped to the Fuel oil storage and Handling System (Section 2.5.11).

Gas which passes through the condensing stages is mainly composed of propane and methane and is considered a NCG. NCG is then utilized within the process and excess NCG sent to the Thermal oxidizer (Section 2.4.9) for destruction.

2.4.8 Cooling

The Project has two closed cold water cooling loops (a chiller and a fin fan cooler) which are used to control process temperature.

2.4.9 Thermal Oxidizer

A Thermal oxidizer is incorporated in the process to destroy (via combustion) any excess gas from the Project which cannot be used within the process. The Thermal oxidizer is totally enclosed, ground mounted and located outside of the Facility as indicated on the Drawing 2.1. The Thermal oxidizer has been configured such that it can receive any excess NCG from the process or excess Propane from the commercial propane supply system. Commercial propane will be used to supply the Thermal oxidizer's pilot light. The Thermal oxidizer has a Rated Heat Capacity which can accommodate all gas produced from the Project in the event that the Condenser must be bypassed. A high turn down ratio allows the Thermal Oxidizer to operate at a lower Design Heat Capacity during nominal system operations.

2.4.10 Fuel Oil Storage and Handling System

A Fuel Oil Storage and Handling System has been design by Eastpoint Engineering (1801 Hollis Street, Suite 1500, Halifax, NS B3J 3N4) to handle and store the fuel oil which is produced from the Project. Fuels produced in the process are separately pumped through overhead piping, across the Facility, into exterior Aboveground Storage Tanks (ASTs) located on the back side of the building. The No. 1 fuel oil produced is then consumed within the Facility as processing heating for the Recycling Project (boiler and biomass dryer)

Details of the liquid fuel oil storage tanks associated with the Project are summarized in Table 2.4 below.

Table 2.4: Liquid Fuel Oil Storage Tank Schedule

Storage Volume (Litres)	Fuel Type	Tank Type	Leak Detection
20,000	No. 1	Above ground, double Walled Steel	Yes
40,000	No. 2	Above ground, double Walled Steel	Yes
49,900	No. 2	Aboveground, double-walled Steel	Yes

2.4.11 Control System

The Project is monitored and controlled using an integrated control system supplied by the Technology provider. The function of the control system during startup, nominal operation, shutdown and emergency scenario is outlined in the Operations Manual provided by the technology provider.

2.4.12 Process Diagrams

A Process Flow and Mass Balance Diagram of the Project has been developed by Sustane which details the inputs, outputs and the flow of material through the Project. The Process Flow and Mass Balance will be submitted to NSE as part of the Project's Industrial Approval Application.

2.5 Environmental Control Features

The Project is to be undertaken in a manner which minimizes disruption to the surrounding environment. This will be achieved by adhering to all applicable Acts and Regulations including the Environment Act (the Act), the Clean Air Act, the Solid Waste- Resource Management Regulations (SWRMR, the Regulations). In addition, Sustane has incorporated several environmental control features which are detailed in this Section.

2.5.1 Pyrolysis

The Project uses Pyrolysis to convert the Plastic feedstock into liquid fuels. This is an environmentally friendly process as the process occurs in an oxygen free environment. This reduces the potential generation of air borne contaminants when compared to Combustion. The majority of the gas produced from pyrolysis is either converted into a liquid fuel or used for process heating. Excess gas is sent to the Thermal oxidizer.

2.5.2 Dedicated Air Handling

A dedicated air handling system (AHS) has been installed in the Pyrolysis Area within the facility. The AHS consists of a ring main around the Pyrolysis Area with a dedicated, ground mounted Air Handling Unit (AHS) located outside of the facility. The AHS maintain proper ventilation of the Pyrolysis under normal operating conditions. In emergency scenarios, two additional wall mounted exhaust fans with louvers can be employed along with the AHS, while opening the bay doors, to ventilate the Pyrolysis Area.

2.5.3 Thermal Oxidizer

A Thermal oxidizer, detailed in Section 2.4.9, has been incorporated in the design to destroy any excess NCG produced from the before it is emitted to the environment. Air emissions from the thermal oxidizer are detailed in Section 2.8.2. The thermal oxidizer is enclosed to reduce noise and light emissions.

2.5.4 Plastic Feedstock Preprocessing and Monitoring

Sustane intends to reduce the potential for toxic air emissions, such as dioxins and furans, by utilizing a plastic feedstock which meets the strict plastic feedstock guidelines detailed in Section 2.3.2. Sustane will ensure that the plastic feedstock meets the plastic feedstock guidelines by employing advanced preprocessing and ongoing monitoring of the Plastic feedstock before it is processed by the Project. Details of the preprocessing and monitoring are detailed in Section 2.3.

2.5.5 Separation Distances

The location of the Project has been chosen in part due to its separation from sensitive human and ecological receptors. Separation distances from nearby receptors are indicated on the Site Plan (Drawing 1.1) and are summarized in Table 2.5 below.

Table 2.5: Separation Distance Summary

Receptor	Separation Distance (m)
Nearest Building Foundation	129
Nearest Commercial Site	550
Nearest Residential Dwelling	3,600
Nearest Wetland	120 m South
Nearest Watercourse	200 m East

2.5.6 Water Consumption

Water will be supplied to the Facility and the Project from two drilled wells located on the Site. The location of the wells is indicated on Drawing 2.1 and both wells are registered with NSE. The only water consumed from the Project will be makeup water for the closed loop cooling system detailed in Section 2.4.8. Total water consumption for both Project and the Recycling project will be approximately 9,600 liters/ day.

2.5.7 Closed Loop Cooling System

The Project requires cooling to moderate process temperature. Sustane has chosen to utilize a closed loop water cooling system in order to reduce the amount of water consumed by the process.

2.5.8 Impermeable Floor

The Project is to be located within the Facility on an impermeable concrete floor. In the event of an accidental release from the Project any deleterious substances will be contained within the Facility and disposed of in accordance with the contingency plan (Section 2.7). There are no floor drains located within the Pyrolysis Area.

2.5.9 Storage Vessels

The Project requires several exterior storage vessels. Table 2.6 summarizes the required storage vessels, excluding fuel oil storage tanks and various storage vessels associated with the Recycling Project, which are detailed in Section 2.5.11.

Table 2.6: Storage Vessel Summary

Storage Vessel	Maximum Volume (m^3)	Stored Material	Notes
Plastic Silo	138	Plastic Feed stock (solid)	Covered, steel silo
Char Storage	3	Char discharge	Covered waste container

2.5.10 Self-Contained Process

The Project has been designed to use a completely enclosed process as detailed in Section 2.4. This reduces the potential of an accidental discharge of solids, liquids or gasses.

2.5.11 Fuel Oil Storage and Handling System

A fuel oil storage and handling system has been engineered by Eastpoint Engineering. This system incorporates various safety measures as required under fuel handling regulations.

2.5.12 Char Disposal

Char produced from the Project will be temporarily stored on Site in a covered storage vessel. Char will be disposed of at the KMEMC in order to prevent any discharge to the environment. Char is further detailed in Section 2.8.3.

2.6 Environmental Protection Plan

An environmental protection plan (EPP) has been prepared to address and mitigate any potential impacts the Project may have on the Environment. The EPP table of contents has been provided with this application (Appendix C).

2.7 Contingency Plan

Sustane will provide a more detailed Contingency Plan to NSE for review and approval as part of the Industrial Approval Application. The contingency plan shall be in accordance with the NSE's Contingency Planning Guidelines (May 10, 2016) and will deal with any reasonably foreseeable sudden or gradual release of a substance that is likely to have an adverse effect.

2.8 Project Effluent Description

The following sections detail the expected effluent streams to be generated by the Project under normal operations.

2.8.1 Liquid Effluent Description

There are no liquid effluents from the Project. All liquids produced from the Project are petroleum hydrocarbon fuels and are contained within the fuel oil storage and handling system Section (2.4.10). All liquid fuels will be either consumed on site or transported off site for sale.

All site surfaces will be finished to prevent erosion and sedimentation. Site storm water will be handled by engineered storm drainage features. Site finishes will include landscaping, asphalt, concrete, gravel, forest and building foot print. No unmitigated discharges of water from the site will be permitted. The Facility has been sited to maintain adequate setback distances from wetlands and watercourses as detailed in Section 2.5.5.

2.8.2 Air Emissions Description

The only air emissions from the Project will consist of exhaust from the combustion of the propane during the startup and the NCG during operations. Exhaust emissions will be from the Thermal Oxidizer and from exhaust stacks from the three Reformers. As noted elsewhere in the documents, the NCG will be composed of the constituents outlined below in Table 2.7.

Table 2.7: Non-condensable Gas Composition

	Volume %	
Methane	18.7%	CH4
Ethylene	20.1%	C2H4
Ethane	16.3%	C2H6
Propene	29.3%	C3H6
Propane	6.9%	C3H8
n-Butane	3.3%	C4H10
Isobutane	0.3%	C4H10
Pentane	5.1%	C5H12
Isopentane	0.1%	C5H12

An air dispersion model has been completed to evaluate any potential impacts from air emissions from the Project. It should be reiterated that only combustion that occurs in the process is burning of propane and the NCG to produce the heat required for the process. The plastic feedstock is not combusted during the pyrolysis process. A report detailing the air modelling has been provided with this application (Appendix D), and the results are summarized in section 5.1.2. No significant impacts are anticipated from the Project's air emissions.

Air emissions from the Project shall comply with any guidelines prescribed by NSE under the Approval including the guidelines provided under Schedule A (i.e. Maximum Permissible Ground Level Concentrations) of the Air Quality Regulations and Schedule D (i.e. Stack Discharge Limits (at 11% oxygen)) of the Solid-Waste Resource Management Regulations.

2.8.3 Solid Emissions Description

The only solid by-product from the Project is the Char produced from the Reformers. The Char has been analyzed to determine its composition with the certificate of analysis provided in Appendix E. Based on the analysis, the char is mainly composed of the following: Carbon, Hydrogen, Moisture, Nitrogen (<1% by weight), Oxygen, Sulfur (<1% by weight) and Volatile Matter. The Char will be removed from the Reformers and stored in the char storage vessel detailed in Section 2.5.9.

A leachate analysis was completed on a sample of the char to confirm that landfilling is an appropriate disposal method. A NS Landfill Leachate Analysis was completed by Maxxam Analytics Labs in Bedford, NS and the lab results have been provided in Appendix E. There were no exceedances of the NS Landfill Leachate guideline for any parameters analyzed. The char will be disposed of at the KMEMC, under the HSA, in order to prevent any solid discharge to the environment.

2.9 Project Operations

The following items shall be incorporated in the general daily operation of the Project

- All plastics feedstock will be incorporated into the Project in a timely manner. Any excess plastic feedstock will be disposed of in an appropriate manner;
- The Project will be supervised by a 4th class power engineer, registered in Nova Scotia, during any operations;

- Only Feedstock which is identified in Section 2.3 shall be incorporated into the Project;
- Litter shall be controlled on the Site;
- Exposed site surfaces shall be stabilized to prevent erosion and sedimentation.
- Dust shall be controlled to Departmental requirements for particulate emissions.
- Vectors shall be controlled at the facility.
- Signs shall be placed at the entrance to the site indicating the name of the facility, hours of operation, emergency contact, and the materials acceptable at the site.

2.10 Hours of Operation

The Project will operate 24 hours/ day, 7 days a week.

2.11 Facility Construction

Construction of the Project consists mainly of assembly of the equipment and environmental control features (detailed in Section 2.4 and 2.5) within the existing Facility. All construction of the Project will be in accordance with local rules and regulations and in accordance with the NS Occupational Health and Safety

Construction will typically occur during normal working hours, however it may extend to weekend or weeknight hours if required. During construction, noise and dust emissions from the site will be minimized by utilizing best management practices.

2.12 Commissioning

The Pyrolysis Plant commissioning will be undertaken in three (3) phases as follows:

I. Cold Commissioning will consist of electrical and mechanical equipment inspections, piping flushing, piping leak checks, electrical conductor integrity test, electrical motor rotational checks, logic verification, etc.;
II. Warm Commissioning will consist of initial reformer burner system and external thermal oxidizer burner system start up/shutdown testing on propane followed by limited introduction of plastics feedstock into the extruders and rotary reformers to allow cooling and condensing system initial operation and basic functional testing;
III. Hot Commissioning will consist of introducing plastics feedstock into the extruder feed system, extruders and rotary reformers for the production of gasified plastics and introduction to the gas conditioning systems, distillation columns and fuel oil transfer systems. Through Hot Commissioning, the Pyrolysis Plant control system will be tuned and operator training completed.

2.13 Decommissioning

The facility is expected to be in operation for the foreseeable future with proper maintenance, according to market requirements. When permanent shut down of the facility is planned, the Proponent will work with NSE to prepare a final decommissioning and reclamation plan according to regulations at the time.

2.14 Project Schedule

Table 2.8 presents the Project schedule from EA registration to Project decommissioning.

Table 2.8: Project Schedule

Project Activity	Timeline
EA Registration	July 3, 2018
Construction of plant	August 2018
Commissioning	September 2018
Operation	October 2018
Decommissioning	TBD

3.0 ENVIRONMENTAL MANAGEMENT

3.1 Environmental Protection Plan

An EPP will be developed following EA approval of the Project. The EPP will be approved by NSE prior to start of the final commissioning phase of the Project and will detail best practices and mitigation to be employed during the various Project phases. A draft table of contents (TOC) for this EPP is provided in Appendix C. The EPP document is the primary mechanism for ensuring that appropriate mitigation is implemented, as determined through the EA process, to avoid or mitigate potential adverse environmental effects that might otherwise occur from Project activities, and as required by applicable agencies through permitting processes.

The EPP is a plan for reference by all Project personnel, including sub-contractors, and describes the responsibilities, expectations, and methods for environmental protection associated with Project activities. The EPP will incorporate:

- means to comply with requirements of relevant legislation;
- industry best management practices;
- environmental protection measures identified as part of the EA;
- monitoring, maintenance, and inspection requirements;
- communication and reporting protocols;
- emergency response and contingency plans; and
- environmental commitments made as part of the EA.

4.0 ENVIRONMENTAL ASSESSMENT METHODOLOGY

The EA focuses on specific components of the biophysical and human environments called Valued Ecosystem Components (VECs) that, if altered by the Project, may be of concern to stakeholders such as regulatory agencies, Aboriginal peoples, resource managers, scientists, and/or the general public. VECs incorporate biological systems as well as human, social, and economic conditions that are affected by changes in the biophysical environment. VECs can therefore relate to ecological, social, and/or economic systems that comprise the environment as a whole. Accidents and malfunctions are considered separately as a VEC.

Interactions between the Project and environmental components are evaluated for potential environmental effects on VECs to determine potential effects and their significance. The determination of significance of adverse environmental effects is based on post-mitigation (residual)

effects, rather than unmitigated potential effects. Therefore, the effects assessment considers the following:

- A review of potential Project interactions;
- Mitigation and environment protection measures proposed to reduce or eliminate adverse effects;
- The characterization of the residual environmental effects of the Project; and
- Any proposed follow-up monitoring to be completed post-construction.

The ultimate focus of the assessment is on residual environmental effects that remain after planned mitigation has been applied.

4.1 Selection of Valued Environmental Components (VECs)

A preliminary assessment of potential interactions between environmental components and Project activities was undertaken to identify VECs (Table 4.1).

Table 4.1: VEC Interaction Matrix

PROJECT PHASES / COMPONENTS	ENVIRONMENTAL COMPONENTS										
	Biophysical						Socio-economic				
	Atmospheric Environment	Geological Environment	Fish and Fish Habitat	Terrestrial Habitat	Terrestrial Fauna	Avifauna	Local Demographics	Land Use and Value	Recreation and Tourism	Cultural and Heritage Resources	Aboriginal Resources
SITE PREPARATION AND CONSTRUCTION											
Installation of facilities and infrastructure	✓	0	0	0	0	✓	0	0	0	0	0
OPERATIONS AND MAINTENANCE											
Daily Maintenance and Operations	✓	0	0	0	0	✓	0	0	0	0	0
DECOMMISSIONING AND SITE REHABILITATION											
Removal of Equipment and Structures	✓	0	0	0	0	0	0	0	0	0	0
Site Rehabilitation	✓	0	0	0	0	0	0	0	0	0	0
ACCIDENTS AND MALFUNCTIONS											
Accidental Release	✓	0	0	0	0	✓	0	0	0	0	0

Notes: ✓ = Potential Interaction, 0 = No Interaction

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Based on the above assessment, the following VECs are expected to have a potential negative interaction with the Project and are therefore addressed in this EA:

- Atmospheric Environment;
- Avifauna.

4.2 Description of Baseline Conditions and Potential Negative Environmental Effects

For each VEC, an overview of the baseline conditions is described. In addition, potential negative effects resulting from interactions with Project activities are described and evaluated in detail for each VEC. Where there is potential for Project-related environmental effects, each effect is assessed using the results of preliminary investigations, guidance from regulators, and the collective knowledge and expertise of the Project team.

4.3 Specific Mitigative and Protective Measures

Where an adverse environmental effect on a VEC is identified, strategies for mitigation, avoidance, or compensation are proposed. Where possible, mitigation measures will be incorporated into Project design to eliminate or reduce potential adverse effects.

4.4 Effects Analysis

The determination and characterization of adverse environmental effects for each VEC is based on post-mitigation (residual) effects, rather than unmitigated potential effects in accordance with the criteria outlined in Table 4.2.

Table 4.2: Criteria for Identification and Definition of Environmental Effects

Attribute	Options	Definition
Scope (Geographic Extent)	Local	Effect restricted to area within 1 km of the Project site
	Regional	Effect extends up to several km from the Project site
	Provincial	Effect extends throughout Nova Scotia
Duration	Short-term	Effects last for less than 1 year
	Medium-term	Effects last for 1 to 10 years
	Long-term	Effects last for greater than 10 years
Frequency	Once	Occurs only once
	Intermittent	Occurs occasionally at irregular intervals
	Continuous	Occurs on a regular basis and regular intervals
Magnitude	Negligible	No measurable change from background in the population or resource; or in the case of air, soil, or water quality, if the parameter remains less than the standard, guideline, or objective
	Low	Effect causes <1% change in the population or resource (where possible the population or resource base is defined in quantitative terms)
	Moderate	Effect causes 1 to 10% change in the population or resource
	High	Effect causes >10% change in population in resource

4.5 Residual Effects Analysis

If, based on the criteria in Table 4.2, a residual effect is identified the significance of the residual effect is then evaluated based on the criteria outlined in Table 4.3.

Table 4.3: Definition of Significant Residual Environmental Effect

Significance Level	Definition
High	Potential effect could threaten sustainability of the resource and should be considered a management concern. Research, monitoring, and/or recovery initiatives should be considered.
Medium	Potential effect could result in a decline in resource to lower-than-baseline but stable levels in the study area after project closure and into the foreseeable future. Regional management actions such as research, monitoring, and/or recovery initiatives may be required.
Low	Potential effect may result in slight decline in resource in study area during life of the Project. Research, monitoring, and/or recovery initiatives would not normally be required.
Minimal/None	Potential effect may result in slight decline in resource in study area during construction phase, but should return to baseline levels.

4.6 Recommended Monitoring and Follow-up

Follow-up and monitoring, in some cases developed in conjunction with regulators, may be recommended to assess effectiveness of measures implemented to mitigate adverse environmental effects.

5.0 ENVIRONMENTAL EFFECTS ASSESSMENT

5.1 Atmospheric Environment

5.1.1 Climate and Weather

Nova Scotia's climate is quite varied and is largely governed by coastal influences and elevation (Davis and Browne 1996). The Project site falls within the South Mountain ecodistrict of the Western ecoregion of Nova Scotia (NSDNR 2018). The western ecoregion is characterized by a milder climate than the rest of Nova Scotia, with significant variations in temperature and precipitation between inland and near-coastal regions (Neily *et al.* 2017). The South Mountain ecodistrict is the largest in the Western ecoregion, with rugged upland of pine and spruce dominated forests. This ecodistrict is also characterized by shallow and coarse textured soils, granite boulders and bedrock exposures, as well as by an abundance of lakes, rivers and wetlands. The climate consists of warm, early springs and warm, dry summers which, when combined with the coarse, shallow soils, creates soil moisture deficits during the growing season. Winters are moderately mild, with the majority of snow accumulation occurring at higher elevations (Neily *et al.* 2017). The typical growing season in the area of the Project site is 203 days (Webb and Marshall 1999).

Climate normals for a 30-year average were determined from the Windsor Martock weather station located 24.6 km from the Study Area and within the South Mountain ecodistrict (EC 2018a).

Mean annual precipitation for the area is 1309.6 mm (Table 5.1). Monthly mean precipitation values range from 76.3 mm in August to 147.1 mm in January. The highest monthly mean rainfall levels occurred in November (17.0 mm), with mean monthly snowfall amounts greatest in January (75.2 cm). Rainfall occurs on average every month; however, snowfall does not occur between June and October.

Table 5.1: Climate Normals for Windsor Martock Weather Station (1981-2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature Normals													
Daily Avg, (°C)	-5.5	-4.4	-0.6	5.3	11.3	16.2	19.9	19.5	15.2	9.4	4.2	-1.6	7.4
Daily Max. (°C)	-1.0	0.2	4.0	10.1	17.1	22.1	25.5	25.1	60.6	14.2	8.0	2.4	12.4
Daily Min. (°C)	-9.9	-9.1	-5.2	0.4	5.5	10.3	14.2	13.9	9.8	4.6	0.3	-5.6	2.4
Ext. Max (°C)	18.5	19.5	27.0	28.5	34.0	34.5	35.0	36.5	34.0	27.5	22.0	17.5	
Ext. Min (°C)	-29.0	-32.5	-22.5	-12.5	-3.0	0.0	5.5	2.5	-2.5	-6.0	-12.5	-24.0	
Precipitation Normals													
Rainfall (mm)	71.9	54.6	83.2	88.6	93.7	82.8	83.9	76.3	105.6	108.8	127.0	84.0	1060.2
Snowfall (cm)	75.2	52.6	42.9	14.7	1.6	0.0	0.0	0.0	0.0	0.0	16.6	45.7	249.4
Precip. (mm)	147.1	107.2	126.1	103.3	95.3	82.8	83.9	76.3	105.6	108.8	143.6	129.7	1309.6

Table 5.2: Wind Normals for Kentville Weather Station (1981-2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Speed (km/h)	42	42	45	43	32	37	32	35	34	34	50	39
Most Frequent Direction	W	NW	W	NW	SE	SW	Calm	SW	SW	SW	NW	SW

Source: EC 2018a

The closest meteorological station where wind speed and direction data is available is Kentville Weather Station, located approximately 43.25 km northwest of the Project site. The average annual wind speed at the station is approximately 38.8 km/h. For five months of the year (May, June. August, September, October, and December) the most frequent wind direction is southwest, with the next most frequent wind direction being northwest during February, April, and November.

In Atlantic Canada, climate change is expected to bring warmer average temperatures, higher sea levels, more extreme rainfalls, and storm flooding, and more frequent and extreme storms (Lemmen *et al.* 2008). Regional trends in seasonal temperatures for Atlantic Canada show an overall warming of 0.3 °C from 1948 to 2005 (Lewis 1997; Lines *et al.* 2003). Precipitation increased in Atlantic Canada by approximately 10% between 1948 and 1995 (Lewis 1997), and is anticipated to continue to increase in the future. The Atlantic region is subject to impacts from a wide range of seasonal and interannual events, including winter cyclonic storms, tropical cyclones, and other severe weather events; summer heat and drought; early or late season frost; winter rain and thaw events; and river ice jams and flooding. There is evidence of recent trends toward greater extremes and higher frequencies of such events (Zhang *et al.* 2001; Beltaos 2002; Bonsal and Prowse 2003; Bruce 2005; Webster *et al.* 2005).

5.1.2 Air Quality

The Government of Canada has established ambient air quality standards for fine particulate matter over two-time averaging periods, while the Government of Nova Scotia has legislated Air Quality Regulations under the *Nova Scotia Environment Act* (Table 5.3).

Table 5.3: Summary of Regulations Pertaining to Ambient Air Quality in Nova Scotia

Contaminant	Averaging Period	Regulatory Threshold (ug/m^3)	
		Federal[1]	Provincial[5]
Carbon Monoxide (CO)	1-hour	-	34,600
	8-hour	-	12,700
Nitrogen Dioxide (NO_2)	1-hour	-	400
	Annual	-	100
Sulphur Dioxide (SO_2)	1-hour	-	900
	24-hour	-	300
	Annual	-	60
Total Suspended Particulate (TSP)	24-hour	-	120
	Annual	-	70
Particulate Matter Less than 10 microns (PM_{10})	24-hour	-	-
Particulate Matter Less than 2.5 microns ($PM_{2.5}$)	24-hour[2]	28 (2015) 27 (2020)	-
	Annual[3]	10 (2015) 8.8 (2020)	-
Ozone (O_3)	1-hour	-	160
	8-hour[4]	135 (2015) 133 (2020)	-

Notes:

[1] Canadian Council of Ministers of the Environment Canada-Wide Standards for $PM_{2.5}$

[2] 3-year average of the annual 98th percentile of the daily 24-hour average concentrations

[3] 3-year average of the annual average concentrations

[4] 3-year average of the annual 4th highest daily maximum 8-hour average concentrations

[5] Nova Scotia Air Quality Regulations (NS Reg. 179/2014)

Nova Scotia monitors air quality at six stations throughout the province. Measured parameters include ground-level ozone (O_3), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and nitrogen dioxide (NO_2). These values are used to calculate a score on the Air Quality Health Index (AQHI) (EC 2016b). The AQHI is a scale from 1-10+, in which scores represent the following health risk categories: Low (1-3), Moderate (4-6), High (7-10), and Very High (10+). The closest AQHI monitoring station to the Project site is located in Kentville. The AQHI at this site is usually low at all times of the year (EC 2018b).

5.1.3 Potential Interactions and Effects

The proposed Project may adversely impact the atmospheric environment during construction, operation and decommissioning. Potential impacts include:

- Release of fugitive dust during construction and operations;
- Release of exhaust emissions during construction;
- Contributing greenhouse gas emissions to the atmosphere.

Fugitive Dust Emissions
Fugitive dust emissions consist of particulate matter (PM) generated from open air activities associated with the construction (e.g. moving earth/disturbing soil, wind erosion, increase in traffic) phase of the Project. They are composed mainly of soil minerals, but can also contain salt, pollen, spores, and tire particles. There are two forms of PM that are of particular interest, as they pose the greatest concern for human health: particulate matter with a diameter of 10 microns (µm) or less (PM_{10}), and particulate matter with a diameter of 2.5 µm or less ($PM_{2.5}$). Particulate matter is measured by Total Suspended Particles (TSP) and is defined as the mass of airborne particles having a diameter of less than 44 microns (µm). Refer to Table 5.3 for the regulatory threshold, and to section 5.1.4 for mitigation measures and best management practices.

Tailpipe/Diesel Exhaust Emissions
Construction activities will result in an increase of combustion product, or tailpipe, emissions; primarily PM, NO_x, SO_2, and CO from vehicles (personal, delivery) and heavy equipment. These emissions are considered to be short-term, localized, and negligible. Refer to section 5.1.4 for mitigation measures and best management practices.

Plastics Pyrolysis Emissions
Air dispersion modelling for the Project was done by the Ramboll in Mississauga Ontario. Guidance provided by the US Environmental Protection Agency and the Ontario Ministry of Environment and Climate Change was used to prepare emission estimates and air dispersion modeling for the Project. A summary of the modeling results is presented below. The detailed modeling report is included in Appendix D.

Emission Estimates
Emissions from the Project were estimated using expected maximum load based on the equipment design. The only combustion emissions from the Project are from the combustion of propane during the system start up and the combustion of the non-condensable gas generated during the process (see Section 2.8.2). Real-case emission rates were also estimated using published emission factors for similar processes. Table 5.4 summarizes the annual emission rate estimates.

Table 5.4: Annual Emission Rates

Emissions	SO_2 (MT/y)	NO_x (MT/y)	CO (MT/y)	TSP (MT/y)	VOC (MT/y)
Design[1]	0.05	7.26	4.07	0.39	0.53
Nominal[2]	0.02	2.64	1.48	0.14	0.19

[1] Based on the maximum rated capacity of the equipment used in the Project's design.
[2] Based on the nominal (i.e. long-term average output) usage rate of 60% for the main system burners, and 13% for the secondary combustion system.

Note that emissions are channeled to flare stack during system start up. Start-up emission estimates are expected to be comparable to expected emissions for the main system burners when operating.

Dispersion Modeling
Estimated emissions were modeled conservatively assuming the three process stacks and the flare operate continuously and simultaneously at their maximum (design) load. Location, elevation, and

estimated maximum emission rates were incorporated into the model. Considerations were also given to:

- Nearby buildings (building downwash can influence dispersion point sources
- Terrain
- Meteorological data - from the Halifax International Airport weather station (EC 2018a)

The model generated results for a 20 km x 20 km area centered on the Project site. The highest modelled concentrations for 1 hour, 8 hour, daily average, and annual average over five years are summarized in Table 5.5 and compared with the limits set in the Nova Scotia Air Quality Regulations (NS Reg. 179/2014).

Table 5.5: Summary of Modelled Emission Concentrations

Contaminant	Average Period	Maximum Permissible Ground level Concentration (µg/m³)	Maximum Modelled Ground Level Concentration (µg/m³)	Percent of Limit
Carbon Monoxide (CO)	1 hour	34600	48.4	0.14%
	8 hours	12700	29.7	0.23%
Hydrogen Sulfide (H_2S)	1 hour	42	7.70E-04	0.002%
	8 hours	8	3.20E-04	0.004%
Nitrogen Dioxide (NO_2)	1 hour	400	86.2	21.55%
	Annual	100	6.72	6.72%
Ozone (O_3)	1 hour	160	<21.46	<13.41%
Sulphur Dioxide (SO_2)	1 hour	900	0.594	0.07%
	24 hours	300	0.239	0.08%
	Annual	60	0.046	0.08%
Total Suspended Particulate (TSP)	24 hours	120	7.218	6.02%
	Annual	70*	1.910	2.73%

This modeling indicates that even with the highly conservative assumptions made in the modelling approach, the air quality in the general area of the Project site would still be well within the limits of the air quality standards listed in Table 5.3. The detailed air dispersion modeling report prepared by the Ramboll Group is included in Appendix D.

5.1.4 Specific Mitigative and Protection Measures

An air emissions management plan will be developed and incorporated into the EPP to monitor and manage air emissions throughout the life of the Project. The plan will include an air quality monitoring plan to monitor air quality in the area of the Project site, and refine the air emissions management plan as necessary to keep air emissions to a minimum.

5.1.5 Potential Residual Effects

An analysis of the residual effects on the atmospheric environment is provided in Table 5.6. It is anticipated that with the implementation of the recommended mitigation measures, project activities will not have significant residual effects on the atmospheric environment.

Table 5.6: Determination of Residual Effects to Atmospheric Environment

VEC	Potential Effect	Significance Criteria	Residual Effects	Significance of Residual Effects
Atmospheric Environment	Airborne particulates and dust (construction)	Scope: Local Duration: Short-term Frequency: Once Magnitude: Low	No	No
	Increased noise levels (construction and operation)	Scope: Local Duration: Long-term Frequency: Continuous Magnitude: Low	No	No
	Air emissions (operation)	Scope: Regional Duration: Continuous Frequency: Long-term Magnitude: Low	Minimal/None	No
	Accidents or Malfunctions resulting in unexpected emissions (construction, operation)	Scope: Local Duration: Short-term Frequency: Once Magnitude: Negligible	Minimal/None	No

Given the scale of the Project (i.e., Demonstration Facility), Project-related emissions are anticipated to be temporary, localized, and minor in nature. Vehicles, vessels, and equipment will be regularly inspected and maintained and idling of equipment will be restricted, where feasible. Measurable changes to the atmospheric environment are not expected. Noise and vibration in the marine environment are further discussed in Section 5.3.

With above mitigation, the potential for significant adverse environmental effects is not likely. No further assessment required.

5.1.6 Recommended Monitoring and Follow-up

An Air Monitoring Plan will be developed and incorporated into the EPP, which will be submitted to NSE for approval prior to final commissioning of the Project. It is recommended that ambient air quality monitoring take place at the Project site for the first year of operations to confirm the results of the modelling. In addition, stack emissions should be sampled on a quarterly basis during the first year of operation to ensure compliance with regulated limits.

5.2 Geologic Environment

5.2.1 Terrestrial Geology

Physiography and Topography

The Project site falls within the South Mountain ecodistrict of the western ecoregion of Nova Scotia (NSDNR 2018). The South Mountain ecodistrict is the largest in the Western ecoregion and the

second largest in the province, extending 150 km in a long arc from east of Sissiboo River to Panuke Lake, and 75 km north to south. It includes the highest elevations in western Nova Scotia at about 298 m, with a mean elevation of 175 m above sea level. It is characterized by shallow and coarse textured soils, granite boulders and bedrock exposures, as well as by an abundance of lakes, rivers and wetlands, including the headwaters of some of the longest rivers in Nova Scotia (e.g. Medway, Mersy, LaHave, Jordan and Roseway) (Neily *et al.* 2017).

Surficial Geology
Surficial geology at the Project site is Silty Till Plain which is described as silty, compact, material derived from both local and distant sources (Stea *et al.* 1992, Drawing 2.2). The till is thick (3 – 30 m) enough to mask bedrock undulations, creating a topography that is flat to rolling, with few surface boulders (Stea *et al.* 1992).

Bedrock Geology
The Project site lies within a Plutonic groundwater region (Kennedy and Drage 2008), with bedrock dating back to the Middle - Late Devonian period consisting of slate, marble, schist, gneiss, and amphibolite. The major rock type is muscovite biotite monzogranite (Keppie 2000, Drawing 2.3).

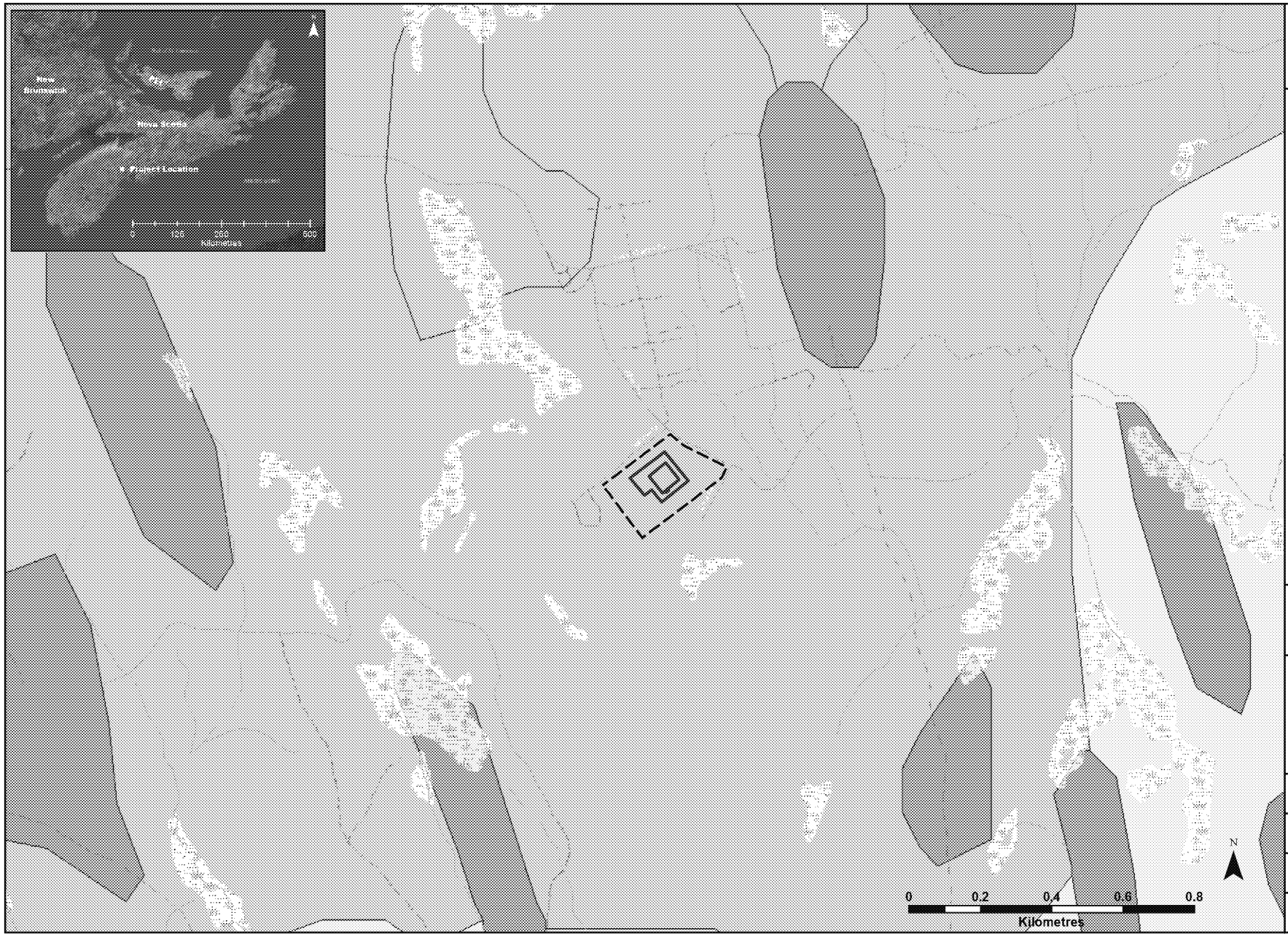
Granites have low matrix permeability and fracture systems contribute the only significant permeability in these rocks. Trescott (1969) reported that permeability in granite is found almost entirely in joints except near the surface where the release of confining pressure by erosion of the overlying rock has allowed fractures to open and where weathering has increased the aperture of many fractures. A large hydrothermal deposit (U-Ag) occurs approximately 16 km north of the Project site at Levy Meadow Brook (formerly Millet Brook) (Chatterjee and Strong 1984).

5.2.2 Potential Interactions and Effects
The proposed Project is not expected to adversely impact the geologic environment during construction, operation or decommissioning as the Pyrolysis Plant will be constructed and operated from within the Advanced MSW Recycling Demonstration Facility building.

5.2.3 Specific Mitigative and Protection Measures
Mitigative measures to minimize the environmental effects of the Project on the geologic environment include:

- A spill contingency plan will be developed and included in the Project's EPP.

5.2.4 Potential Residual Effects
An analysis of the residual effects on the geologic environment is provided in Table 5.7. It is anticipated that with the implementation of the recommended mitigation measures, significant adverse environmental effects on geologic environment are not likely to occur. The activities associated with construction and decommissioning of the facility will have limited to no interaction with the geologic environment (i.e., minor excavation and no blasting anticipated).



Notes:

1. Data Sources: GeoNOVA, NSTD, Sustane.
2. Basemap: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
3. Projection: NAD83 UTM Zone 20 North.

Legend:

- Advanced MSW Recycling Building
- PID60704418

Transportation

- Local Road
- Unpaved Road
- Driveway
- Track

Water Features

- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area

Surficial Geology By Unit

- Organic Deposits
- Silty Drumlin
- Silty Till Plain
- Stony Till Plain

Sustane Chester Inc. Pyrolysis Plant - Surficial Geology

Strum Environmental

*Engineering * Surveying * Environmental*
*Bedford * Antigonish * Moncton * Deer Lake*

Date: June 2018	Project #: 18-6355
Scale: 1:10,000	Drawing #: 2.2
Drawn By: M. Marriott	
Checked By: S. Duncan	

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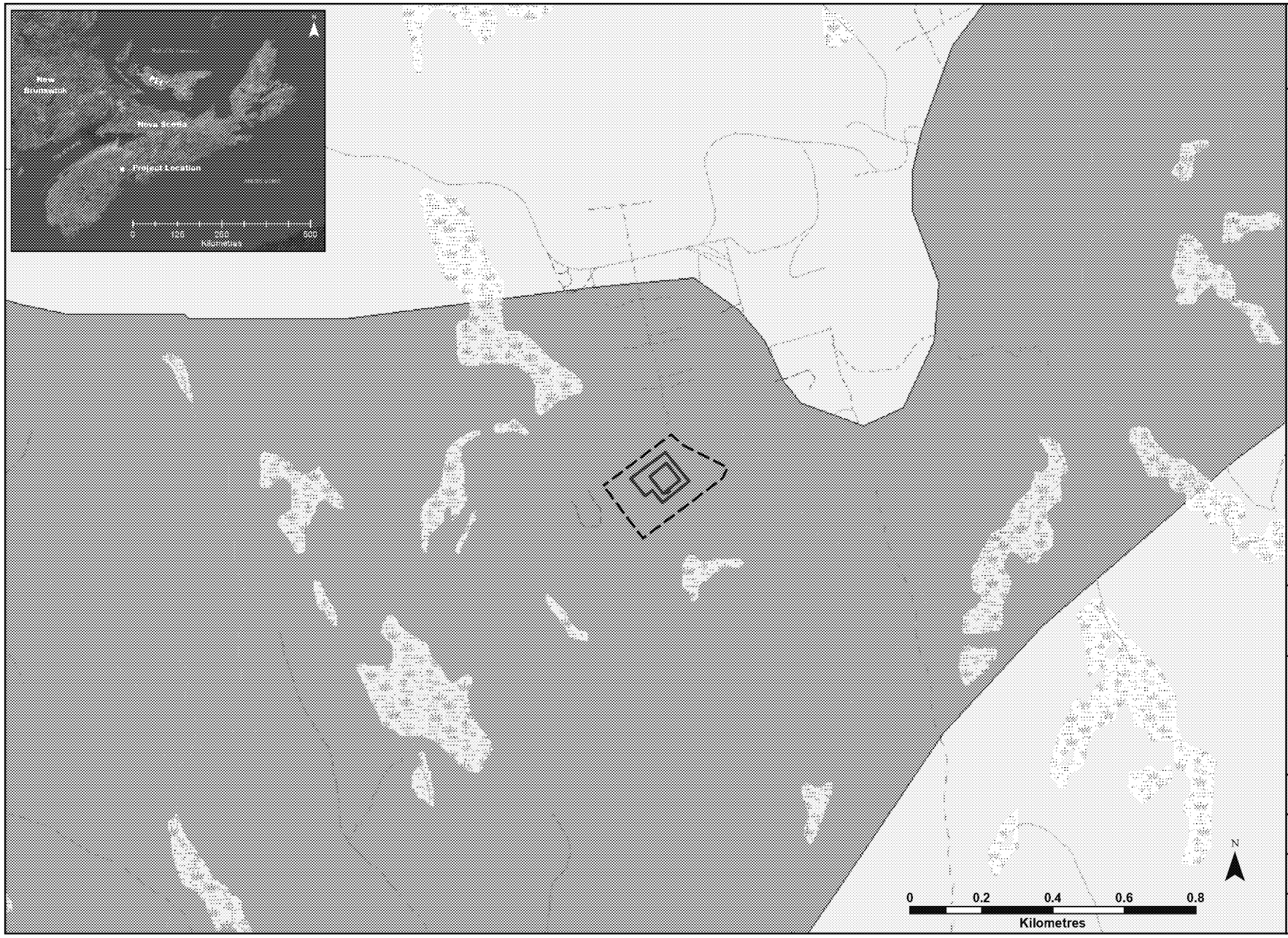


Notes:

1. Data Sources: GeoNOVA, NSTD, Sustane.
2. Basemap: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
3. Projection: NAD83 UTM Zone 20 North.

Legend:

- Advanced MSW Recycling Building
- PID60704418

Transportation

- Local Road
- Unpaved Road
- Driveway
- Track

Water Features

- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area

Bedrock Geology By Formation

- Middle - Late Devonian muscovite biotite monzogranite
- Middle - Late Devonian leucomonzogranite

Sustane Chester Inc. Pyrolysis Plant - Bedrock Geology

Strum Environmental

*Engineering * Surveying * Environmental*
*Bedford * Antigonish * Moncton * Deer Lake*

Date: June 2018	Project #: 18-6355
Scale: 1:10,000	Drawing #: 2.3
Drawn By: M. Marriott	
Checked By: S. Duncan	

ED_005952_00000667-00040

Table 5.7: Determination of Residual Effects to the Geologic Environment

VEC	Potential Effect	Significance Criteria	Residual Effects	Significance of Residual Effects
Geologic Environment	Accidental release of deleterious substances (e.g. spill)	Scope: Local Duration: Short-term Frequency: Once Magnitude: Negligible	Minimal/None	N/A

All required municipal and provincial permits will be obtained. Significant adverse environmental effects are not likely to occur. No further assessment required.

5.2.5 Recommended Monitoring and Follow-up

An EPP will be developed and approved by NSE prior to final commissioning of the Project.

5.3 Freshwater Environment

5.3.1 Waterbodies and Watercourses

The Project site is located in the East River Chester Secondary Watershed within the East/Indian River Primary Watershed. The secondary watershed is a 19.2 km^2 area that flows south to the Atlantic Ocean. There are two lakes within the secondary watershed; Anderson Lake located approximately 1.6 km to the northeast, and North Bog Lake located approximately 2.7 km to the southeast of the Project site.

Groundwater

There is one drilled well within 1.5 km of the Project site, located along Rainbow Drive. The well is drilled through boulders to a depth of 140.2 m, encountering granite bedrock at 0.8 m (Kennedy and Fisher 2013). The surrounding communities are serviced by individual wells and the nearest municipal water supplies are in Windsor and Mahone Bay, over 30 km from the Project site, since the decommissioning of Mill Cove (~19 km away) (Williams 2017).

Surface Water

A review of the Nova Scotia Hydrographic Network within the Nova Scotia Topographic Database indicates there are no mapped wetlands, streams or waterbodies within the boundaries of the Project site. Prominent water bodies in the surrounding area include Anderson Lake (approximately 1.6 km to the northeast), Card Lake (approximately 2.3 km to the west), Shea Lake (approximately 2.0 km to the southwest), Bog Lakes (approximately 2.7 km to the southeast), Bag Lake (approximately 3.8 km to the northwest), and Timber Lake (approximately 4.6 km to the southeast).

Water quality data was obtained from the Lake Inventory Program (NSE 2012) for lakes located within 20 km of the Project site. Water quality data results for 31 lakes in the area were relatively consistent with few apparent observations. Dissolved oxygen (DO) levels higher than 2 mg/L are considered optimal for aquatic life and this concentration was observed in all cases except some bottom samples. Conductivity levels were highly variable and water clarity ranged from 1.1 m to 3.45 m. All lakes surveyed reported acceptable pH levels (guideline 5.0 – 9.0) (CCME 2003, Health Canada 2012) and surface DO levels (variable but ≥5.5 mg/L based on water temperature and life

stage) (CCME 1999) based on water quality guidelines for the protection of aquatic and recreational use guidelines.

5.3.2 Fish and Fish Habitat

A review of the Atlantic Canada Conservation Data Center (ACCDC) database for fish and aquatic invertebrate species recorded within a 100 km radius of the Project site was completed. All species, including status rankings, are provided in Table 5.8.

Table 5.8: Fish and Aquatic Invertebrate Species Recorded Within a 100 km Radius of the Project Site

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NSESA Status[3]	NS GS-Rank[4]	NS S-Rank[4]
Fish						
Atlantic Whitefish	*Coregonus huntsmani*	Endangered	Endangered	Not Listed	Exotic	S1
Atlantic Salmon *Inner Bay of Fundy pop.	*Salmo salar* **Salmo salar pop. 1*	Not Listed *Endangered	Not Listed *Endangered	Not Listed *Not Listed	*May Be At Risk	*S1
Striped Bass *Bay of Fundy pop.	*Morone saxatilis* **Morone saxatilis pop. 2*	E,E,SC *Endangered	*Not Listed	Not Listed *Endangered	*May Be At Risk	S2S3 *S1B
Atlantic Sturgeon	*Acipenser oxyrinchus*	Threatened	Not Listed	Not Listed	May Be At Risk	S2
American Eel	*Anguilla rostrata*	Threatened	Not Listed	Not Listed	Secure	S2
Alewife / Gaspereau	*Alosa pseudoharengus*	Not Listed	Not Listed	Not Listed	Sensitive	S3
Brook Trout	*Salvelinus fontinalis*	Not Listed	Not Listed	Not Listed	Sensitive	S3
Lake Trout	*Salvelinus namaycush*	Not Listed	Not Listed	Not Listed	Sensitive	S3
Aquatic Invertebrate						
Brook Floater	*Alasmidonta varicosa*	Special Concern	Not Listed	Not Listed	Sensitive	S1S2
Eastern Pearlshell	*Margaritifera margaritifera*	Not Listed	Not Listed	Not Listed	Sensitive	S2
Triangle Floater	*Alasmidonta undulata*	Not Listed	Not Listed	Threatened	Secure	S2S3
Eastern Lampmussel	*Lampsilis radiata*	Not Listed	Not Listed	Not Listed	Sensitive	S3S4

Source: ACCDC 2018; [1] COSEWIC 2018; [2] GC 2017; [3]NSDNR 2017b; [4]ACCDC 2018

The Atlantic whitefish (*Coregonus huntsmani*) is an endemic species restricted to three lakes (Hebb, Milipsigate, and Minamkeak) in the Petite Rivière watershed, near Bridgewater, Nova Scotia (COSEWIC 2010b). This population is landlocked and complete their life cycle in these lakes and

connecting streams (COSEWIC 2010b). No further consideration of effects and mitigation specific to this species has been undertaken.

The alewife/gaspereau is the collective name given to two alosid species that are often found together and are difficult to distinguish: the Alewife (*Alosa pseudoharengus*) and the Blueback herring (*Alosa aestivalis*). They are listed in DFO fishery records as Alewife. Alewife/Gaspereau are anadromous species, migrating into freshwater in the spring to spawn. Spawning adults spend little time in freshwater, returning immediately to the sea (Bigelow and Schroeder 2002). Adults and juveniles will spend the summer in the Minas Basin, feeding on plankton, including copepods, amphipods, and shrimp, as well as occasionally smaller fish species (Bigelow and Schroeder 2002). There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

The striped bass is an anadromous species typically associated with estuaries and coastal waters, which spawns and over-winters in fresh and occasionally brackish water. In Nova Scotia, the Annapolis River and the Shubenacadie–Stewiacke River system in the Bay of Fundy historically supported spawning populations (COSEWIC 2012b). Today, the species is known to spawn only in two river systems in eastern Canada: the Miramichi and the Shubenacadie-Stewiacke systems. Catches have been recorded throughout the province, including in the Avon and Annapolis rivers, River Phillip, Shubenacadie (Grand) Lake, and the Minas Basin. There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

The American eel (*Anguilla rostrata*) is a catadromous species that spawn once in their lives in the Sargasso Sea, located in the southern Atlantic Ocean (COSEWIC 2012a). The young larvae migrate back towards coastal and freshwater streams where they live until maturity (COSEWIC 2012a). They inhabit a variety of freshwater and estuarine habitats throughout their lifetime and prey includes fishes, molluscs, crustaceans, insect larvae, surface-dwelling insects, worms and plants (COSEWIC 2012a). The American ell is listed as 'Threatened' by COSEWIC, but is widespread through eastern Canada (COSEWIC 2012a). However, it is in significant decline throughout other portions of its distribution, such as in Lake Ontario and the upper St. Lawrence River (COSEWIC 2012a). It commonly overwinter by burrowing in muddy substrates (COSEWIC 2012a). There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

The Atlantic salmon (*Salmo salar*) is an anadromous species native to the North Atlantic Ocean and coastal rivers, which undertakes long feeding migrations to the ocean as older juveniles and adults, and return to freshwater streams to reproduce. The species requires rivers that are clear, cool and well oxygenated, with pools and shallow riffles and gravel, rubble, rock or boulder bottoms for reproduction (COSEWIC 2010a). There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

The Atlantic sturgeon (*Acipenser oxyrinchus*) live in rivers, nearshore marine environments and the continental shelf regions along the Atlantic coast (COSEWIC 2011). They are a slow-growing species, maturing at 16-24 years for males and 27-28 years for females, and can reach sizes upwards of 3 m (COSEWIC 2011). The maritime population spawns predominantly in the lower Saint John River area (COSEWIC 2011). There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

The brook trout (*Alasmidonta varicosa*) are a migratory species with some individuals spending their lives in freshwater, and others migrating to sea water annually during the spring; these are referred to as 'Sea-run'. In the fall, brook trout migrate to a freshwater spawning location within riffled streams, with fry emerging in the spring (NSL 2017). Sea-run individuals remain in freshwater until they are 2-3 years of age, and then begin migrating to salt water in the spring. Perpetual freshwater species migrate much shorter distances to larger rivers or lakes during the summer (MacMillan and LeBlanc 2002; Mills 1971). There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

The lake trout (*Salvelinus namaycush*) thrive in large, deep lakes with a cold water and a well-oxygenated hypolimnion. They normally inhabit only lakes with a depth greater than 50 feet due to their requirement for cold, deep waters (OFS 2017). Although active near the water surface during the winter, they begin moving from shallow waters into deep regions of lakes once surface water temperatures begin to warm in the spring (NSDAF 2005). Spawning generally occurs on rocky reefs or shoals when water temperatures are between 6 and 15°C. They are the only *Salvelinus* species that is restricted to freshwater. Due to their lake depth requirements, lake trout are uncommon in Nova Scotia and relatively little is known about them (NSDAF 2005). There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

The vast majority of brook floater (*Alasmidonta varicosa*) populations occur in running water habitats with a wide range of flow conditions; from small creeks and streams to large rivers (COSEWIC 2009a). In Nova Scotia, brook floaters also occurs in small and medium-sized lakes with no evident water flow (COSEWIC 2009a). Brook floaters prefer waters with a pH greater than 5.4, indicating that acidity may be an important factor (COSEWIC 2009a). Brook Floater has a complex life cycle and relies on a fish host to complete its life cycle. There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

The Eastern pearlshell (*Margaritifera margaritifera*) is an elongated shaped mussel, with a light brown to black coloured shell without rays (CDEP 2013). It is found in streams and small rivers that support trout or salmon populations and exist in a variety of substrate (CDEP 2013). Their thick shell allows them the ability to withstand fast flowing, rocking conditions unlike other mussel species. This species is not found in lakes or ponds (CDEP 2013). There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

The Eastern lampmussel (*Lampsilis radiata*) is a medium to large freshwater mussel that is widely distributed across the northeastern United States and Canada, occurring in Nova Scotia, New Brunswick, Quebec and Ontario (McAlpine and Smith 2010). This species inhabits a variety of habitats, including small streams, large rivers, ponds and lakes, and prefers sand or gravel substrate (NatureServe 2017). The life cycle of the Eastern lampmussel is complex and relies on host fish; several species of fish have been confirmed as hosts, including rock bass, bluegill, longear sunfish, smallmouth bass, largemouth bass, white perch, yellow perch and bluntnose minnow, among others (NatureServe 2017). There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

The triangle floater (*Alasmidonta undulata*) has a wide range across the Atlantic Slope, from Nova Scotia west to the St. Lawrence River drainage, and south to Florida (Cordeiro 2011). Northern populations of this species avoid larger rivers, preferring small streams going far up towards the headwaters. This species favours a steady flow of water rather than riffles or rough water. Occasionally, it can be found in lakes, ponds and canals. It lives mostly in a mixture of coarser or finer gravel with sand and mud, or in between large stones (Clarke 1981b). Southern populations are also found in big rivers in muddy sand with moderate current (Heard 1979). There are no waterbodies or watercourses within the Project area to support fish or fish habitat; therefore, no further consideration of effects and mitigation specific to this species has been undertaken.

5.3.3 Potential Interactions and Effects

The proposed Project is not expected to adversely impact the freshwater environment during construction, operation or decommissioning as the Pyrolysis Plant will be constructed and operated from within the Advanced MSW Recycling Demonstration Facility building.

5.3.4 Specific Mitigative and Protection Measures

An EPP will be developed and approved by NSE prior to final commissioning of the Project.

5.3.5 Potential Residual Effects

No residual effects on fish and fish habitat are anticipated.

5.3.6 Recommended Monitoring and Follow-up

Follow-up and monitoring are not recommended at this time.

5.4 Terrestrial Environment

5.4.1 Habitat and Vegetation

The Project site falls within the South Mountain ecodistrict of the Western ecoregion of Nova Scotia (NSDNR 2018). The South Mountain ecodistrict is characterized by rugged upland of pine and spruce dominated forests that have been strongly influenced by a long history of forestry activities and uncontrolled wildfires (Neily *et al.* 2017). The growth potential in this ecodistrict is greatly influenced by the shallow and coarse textured soils, granite boulders and bedrock exposures.

Within the Project site, the predominate species of trees are black spruce (*Picea mariana*) and red spruce (*Picea rubens*), followed by red maple (*Acer rubrum*) and white pine (*Pinus strobus*) (NSDNR 2018). Typical ground vegetation includes bunchberry (*Cornus canadensis*), wild lily-of-the-valley (*Maianthemum canadense*), bluebead lily (*Clintonia borealis*), sarsaparilla (*Aralia nudicaulis*) and star flower (*Trientalis borealis*), with bracken fern (*Pteridium aquilinum*) found at poorer sites (Neily *et al.* 2017).

A review of the ACCDC database for recorded observations of vegetative species within a 100 km radius of the study area was completed. The ACCDC database review identified 318 vascular and 130 nonvascular plant SOCI within a 100 km radius (ACCDC 2018) (Appendix F).

The majority of the surrounding area is used for landfill activities and has been cleared of vegetation to accommodate landfill infrastructure (i.e. landfill cells, water retaining ponds, maintenance building, waste/refuse storage areas, access roads). In these disturbed areas, intermittent congregations of balsam fir and birch species shrubs and saplings have been observed adjacent to access roads. Ground vegetation in these areas is dominated by mixed grass species which are typically used as a method to stabilize exposed surface soils on landfill cells, in addition to cattails which colonize wet ditches and low lying areas adjacent to access roads and landfill cells.

5.4.2 Wetlands

A review of the aerial imagery, the Nova Scotia Wet Areas Mapping Database and the Nova Scotia Hydrographic Network within the Nova Scotia Topographic Database indicates there are no mapped wetlands, streams or waterbodies within the boundaries of the Project site (Drawing 5.1).

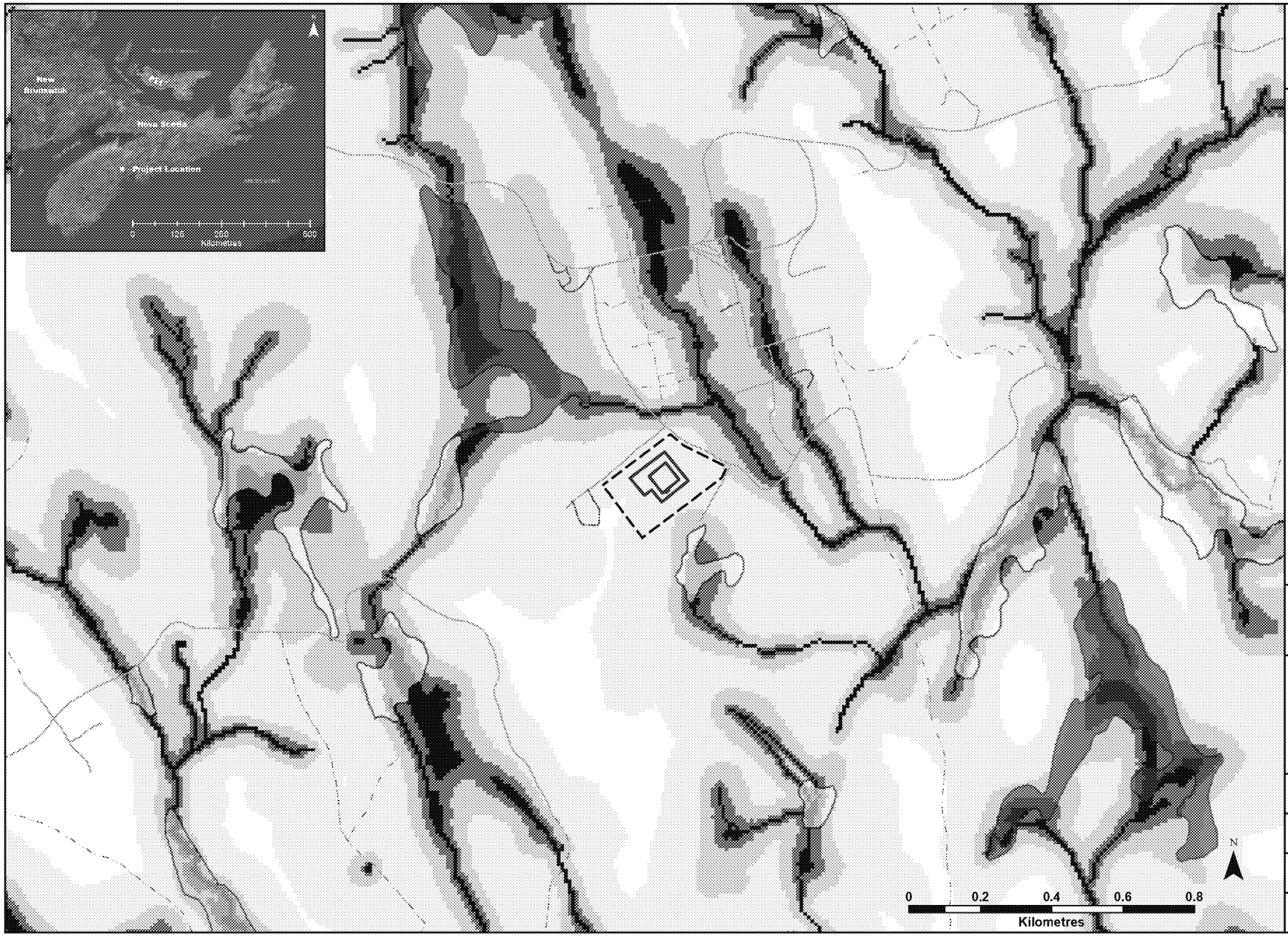
The nearest wetland is approximately 218 m south of the project site with no apparent pathway to allow for interaction from the Project. Therefore, no further consideration of effects and mitigation specific to this VEC has been undertaken.

5.4.3 Mammals

The Nova Scotia Significant Species and Habitat Database (NSDNR 2016) contains 15 unique species and/or habitat records pertaining to terrestrial mammals within a 100 km radius of the Project site. These records include:

- Four records classified as “Other Habitat”, relating to the American Beaver (*Castor canadensis*) (1), karst at site of Woodville Ice Cave (no species recorded) (2), and karst (no species recorded) (1);
- One record classified as “Special Concern”, relating to the Fisher (*Pekania pennanti*);
- Eight records classified as “Species at Risk”, relating to the Southern Flying Squirrel (*Glaucomys volans*) (1), the Little Brown Bat (*Myotis lucifugus*) (3), Frenchmans Cave bat hibernaculum (1), bat hibernaculum in abandoned mine (1), bat hibernaculum in gypsum cave (1), and karst and caves (no species recorded) (1).
- Two records classified as “Deer Wintering”, which relate to known over-wintering habitat for White-tailed deer (*Odocoileus virginianus*)’

There are no records relating to significant terrestrial mammal habitat within 10 km of the Project site.



Notes:

1. Data Sources: GeoNOVA, NSTD, Sustane.
2. Basemap: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
3. Projection: NAD83 UTM Zone 20 North.

Legend:

- Advanced MSW Recycling Building
- PID60704418

Transportation

- Local Road
- Unpaved Road
- Driveway
- Track

NS DNR Wetland Inventory (Habitat)

- Bog or Fen
- Marsh
- Swamp

Depth to Water Table (m)

- 0 - 0.10 m
- 0.11 - 0.50 m
- 0.51 - 2 m
- 2.01 - 10 m
- > 10 m

Sustane Chester Inc. Pyrolysis Plant - Desktop Review

Strum Environmental

*Engineering * Surveying * Environmental*
*Bedford * Antigonish * Moncton * Deer Lake*

Date: June 2018	Project #: 18-6355
Scale: 1:10,000	Drawing #: 5.1
Drawn By: M. Marriott	
Checked By: S. Duncan	

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A review of the ACCDC database for recorded observations of mammalian species within a 100 km radius of the study area was completed. The ACCDC database review indicates that 12 terrestrial mammal SOCI have been recorded within a 100 km radius of the Project site (Table 5.9).

Table 5.9: Mammalian Species Recorded Within a 100 km Radius of the Project Site

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NSESA Status[3]	NS GS-Rank[4]	NS S-Rank[4]
Little Brown Myotis	*Myotis lucifugus*	Endangered	Endangered	Endangered	At Risk	S1
Northern Long-eared Myotis	*Myotis septentrionalis*	Endangered	Endangered	Endangered	At Risk	S1
Eastern Pipistrelle	*Perimyotis subflavus*	Endangered	Endangered	Endangered	At Risk	S1
Canadian Lynx	*Lynx canadensis*	Not At Risk	Not Listed	Endangered	At Risk	S1
Long-tailed Shrew	*Sorex dispar*	Not At Risk	Special Concern	Not Listed	Sensitive	S2
Southern Flying Squirrel	*Glaucomys volans*	Not At Risk	Special Concern	Not Listed	Sensitive	S2S3
American Marten	*Martes americana*	Not Listed	Not Listed	Endangered	At Risk	S1
Moose	*Alces americanus*	Not Listed	Not Listed	Endangered	At Risk	S1
Hoary Bat	*Lasiurus cinereus*	Not Listed	Not Listed	Not Listed	May Be At Risk	S1S2B, S1M
Maritime Shrew	*Sorex maritimensis*	Not Listed	Not Listed	Not Listed	Secure	S3
Southern Bog Lemming	*Synaptomys cooperi*	Not Listed	Not Listed	Not Listed	Secure	S3
Fisher	*Pekania pennanti*	Not Listed	Not Listed	Not Listed	Secure	S3

Source: ACCDC 2018; [1] COSEWIC 2018; [2] GC 2017; [3]NSDNR 2017b; [4]ACCDC 2018

American marten prefer mature coniferous forests, and have been more recently observed in mixed forests and cutovers (MTRI 2008). The current known distribution of the American marten in Nova Scotia is limited to Cape Breton and the southwestern part of the province (NSDNR 2012a). ACCDC data indicate that the closest observation of American marten to the Project site was 68.1 km away. Due to their restricted range within Nova Scotia, it is unlikely that the Project will impact this species. No further consideration of effects and mitigation for this species has been undertaken.

Although they can occur in a diversity of habitats, Canada lynx are typically found in coniferous forests with snowshoe hare (their main prey). They require areas with interspersed forest types suitable for different activities, such as those found in previously disturbed forests (insect outbreaks and fire). Deep snow packs are a requirement for Canada lynx. They are most commonly found in areas of high elevation, which can provide them necessary deep snow, around Cape Breton such as Cape Breton Highlands, North Mountain, Keppoch Mountain, and Boisdale Hills (NSDNR 2017b).

Canada Lynx were extirpated from the mainland during the 1950s, but will travel province wide when food is scarce. ACCDC data indicate that the closest observation of Canada Lynx to the Project site was 51.2 ± 1.0 km away. Due to their restricted range within Nova Scotia, it is unlikely that the Project will impact this species. No further consideration of effects and mitigation for this species has been undertaken.

Fisher prefer dense, mature to old-growth forests with continuous overhead cover (Allen 1983). Generally considered a forest-interior species (OMNR 2000), Fisher require large tracts of well-connected habitat (Meyer 2007).

Fisher are distributed throughout mainland Nova Scotia, and trapping data suggests population concentrations in Cumberland, Colchester, and Pictou counties (NSDNR 2017a). Approximately 10% of 1056 Fisher trapped in Nova Scotia between 2010 and 2017 were harvested from Lunenburg County (NSDNR 2017a). ACCDC data indicate that the closest observation of this species to the Project site was 19.1 ± 5.0 km away. This species is often associated with wetland habitat or streams. The lack of a sufficient abundance of mature coniferous forests and wet within the Project site make it unlikely that this species is present in the area. No further consideration of effects and mitigation for this species has been undertaken.

The Little brown myotis is the most common bat species in Nova Scotia, and is probably ubiquitous in the province (Broders *et al.* 2003). During the day, the Little brown myotis will roost in buildings, trees, under rocks, in wood piles, and in caves, congregating in tight spaces to roost at night (Fenton and Barclay 1980). As a non-migratory species, Little brown myotis hibernates from September to early or mid-May in abandoned mines or caves (Fenton and Barclay 1980, Moseley 2007). ACCDC data indicate that the closest observation of this species to the Project site was 32.5 km away. Little brown myotis has historically been recorded in Frenchman's Cave, approximately 30 km away (Moseley 2007). However, this species is suspected to have been most severely affected by the White-nose Syndrome epizootic (COSEWIC 2012c). The disease has killed nearly 7 million bats in eastern North America in the past 8 years. White-nose syndrome is lethal and affects all bat species that congregate in caves and abandoned mines used for hibernation through the winter (NSDNR 2017b).

The majority of the surrounding area is used for landfill activities and has been cleared of vegetation to accommodate landfill infrastructure (i.e., landfill cells, water retaining ponds, maintenance building, waste/refuse storage areas, access roads), making it unlikely that this species is present in the area. No further consideration of effects and mitigation for this species has been undertaken.

Long-tailed shrew are closely associated with steep, talus slopes, usually close to running water, and the presence of rocks is considered a principal habitat component (Kirkland 1981). Thought to be found only in the Cobequid Mountains (Scott 1987, Woolaver *et al.* 1998), more recent research has identified an additional population of Long-tailed Shrew on Stewart Mountain (Shafer and Stewart 2006). ACCDC data indicate that the closest observation of Long-tailed shrew to the Project site was 58 km away.

Due to their restricted range within Nova Scotia, it is unlikely that the Project will impact this species. No further consideration of effects and mitigation for this species has been undertaken.

Habitat requirements for Mainland moose change throughout the year. Early successional growth, such as that provided by regenerating cutovers, offers quality foraging habitat for moose, and interspersed wetlands provide suitable summer habitat for cows and calves (Parker 2003, Snaith and Beazley 2004). Mature softwood forest is used as escape cover throughout the year, and also provides thermal relief during the summer months (Broders *et al.* 2012) and relief from deep snows in winter (Telfer 1970).

Five significant concentration areas for Mainland moose have been identified in Nova Scotia (NSDNR 2012b). The Project site is located <1 km west of the Chebucto (Halifax) Peninsula concentration area and has moose observations as close as 4.6 km south of the Project site from July and August of 2010 (ACCDC 2018, NSDNR moose occurrence data). The most recent moose sighting occurred in July of 2014, ~6.5 km north of the Project site.

The Project site itself does not contain key habitat features to support the year-round needs of Mainland moose as a result of ongoing landfill related activities in the surrounding areas, making it unlikely that moose would be found on site. No further consideration of effects and mitigation for this species has been undertaken.

Maritime shrews are found in Nova Scotia and New Brunswick (Stewart *et al.* 2002). Limited knowledge is available on this species; however research suggests that the species exhibits an apparent affinity for wetland habitats which are highly fragmented in Nova Scotia (Herman and Scott 1992). Its habitat is vulnerable to changes that may result from climate change; and is also vulnerable to flooding, and shrews may be stressed by the absence of snow cover (Herman and Scott 1992).

ACCDC records indicate that the closest observation of this species to the Project site was 92.2 km away. Given the lack of extensive wetland habitat in the Project site area, it is unlikely that this species occurs in the Project site area. No further consideration of effects and mitigation for this species has been undertaken.

The Northern long-eared myotis, although once considered uncommon throughout Nova Scotia (Moseley 2007), is likely ubiquitous in the forested regions of the province (Broders *et al.* 2003). This species is widely distributed in the eastern United States and Canada, and is commonly encountered during swarming and hibernation (Caceres and Barclay 2000). During the day, Northern long-eared myotis show a preference for roosting in trees, the characteristics of which have been shown to vary according to the reproductive status of bred females (Garroway and Broders 2008). Females appear to prefer shade tolerant deciduous trees over coniferous trees, whereas males roost alone in coniferous or mixed-stands in mid-decay stages (Broders and Forbes 2004). Northern long-eared myotis are also non-migratory and are typically associated with the Little brown myotis during hibernation, in caves or abandoned mines (Moseley 2007). Hibernation in this species is thought to begin as early as September and can last until May (as cited in Caceres and Barclay

2000). ACCDC data indicate that the closest observation of this species to the Project site is 32.5 km away.

The majority of the surrounding area is used for landfill activities and has been cleared of vegetation to accommodate landfill infrastructure (i.e., landfill cells, water retaining ponds, maintenance building, waste/refuse storage areas, access roads), making it unlikely that this species is present in the area. No further consideration of effects and mitigation for this species has been undertaken.

Southern flying squirrel requires mast bearing trees for forage and tree cavities for nesting and in the Atlantic Region, southern flying squirrels select older forest stands (COSEWIC 2006c). In Nova Scotia, the species demonstrates a particular affinity to red oak (*Quercus rubra*) which is most commonly found in mixed wood stands as opposed to pure hardwood stands (Lavers 2004). In Nova Scotia, Southern flying squirrel occur primarily in a region bounded by the South Mountain in the north, Kentville in the east, New Ross in Lunenburg County to the south, and extends to Kejiimkujik National Park in the west (COSEWIC 2006). ACCDC data indicate that the closest observation of this species to the Project site is 29.6 km away.

The majority of the surrounding area is used for landfill activities and has been cleared of vegetation to accommodate landfill infrastructure (i.e., landfill cells, water retaining ponds, maintenance building, waste/refuse storage areas, access roads), making it unlikely that this species is present in the area. No further consideration of effects and mitigation for this species has been undertaken.

Southern bog lemming is widely distributed thought southeastern Canada from the maritime provinces to southeastern Manitoba. The prime habitat for lemmings is in moist, grassy areas around sphagnum bogs, swamps and stream edges but can inhabit a wide range of less preferred habitats, such as shrubby grasslands, mixed forests, wet meadows, pasture lands, woodland clearings, and even clear cuts (Naughton 2014). Possible habitat is present on the Project site and therefore it is possible that the Southern bog lemming is present. ACCDC data indicate that the closest observation of this species to the Project site is 58.0 km away.

Given the lack of suitable habitat in the Project site area, it is unlikely that this species occurs in the Project site area. No further consideration of effects and mitigation for this species has been undertaken.

Tri-colored bats, formerly known as the Eastern pipistrelle, forage over water bodies, tree canopies and in open areas (Quinn and Broders 2007; Poissant and Broders 2008). This species requires clumps of *Usnea* lichen for roosting; a habitat feature typically associated with mature spruce and balsam fir trees (Farrow 2007). This species is non-migratory, and generally hibernates alone, or in small numbers, in caves or abandoned mines where it appears to show a preference for small side passages, rather than main passages (Fujita and Kunz 1984; Moseley 2007). Individuals show strong fidelity to specific hibernacula, although in Nova Scotia, only 10 hibernating individuals have ever been recorded (Quinn and Broders 2007).

The species occurs throughout most of eastern North America, with Nova Scotia representing the northeastern extent of its range (Fujita and Kunz 1984). Within Nova Scotia the species has a

restricted breeding distribution focused in the interior of the southwest region of the province (Farrow and Broders 2011). Research conducted at Kejimkujik National Park found the Tri-colored bat to be locally abundant, and results indicate that this population may represent the only breeding population of the species in Canada (Broders *et al.* 2003). In the summer months, the Tri-colored bat is concentrated in a geographic area bounded by Wolfville to the west, Halifax to the northeast, and Shelburne to the southeast (Quinn and Broders 2007). ACCDC data indicates that the closest observation of this species to the Project site was 32.5 km away.

The majority of the surrounding area is used for landfill activities and has been cleared of vegetation to accommodate landfill infrastructure (i.e., landfill cells, water retaining ponds, maintenance building, waste/refuse storage areas, access roads), making it unlikely that this species is present in the area. No further consideration of effects and mitigation for this species has been undertaken.

The hoary bat is a highly migratory species of bat that is widely distributed across Canada and is common in many areas, though it often goes undetected. This bat is one of three lasiusrine bat species that has been recorded in inland, coastal and offshore locations of Nova Scotia, despite the province being thought to be at, or beyond, the northern limits for these species (Lucas and Hebda 2011). Extensive province-wide surveys in 2003 and subsequent monitoring programs have found that 0.4% of echolocation sequences recorded in the province are from lasiurine bats, the majority of which are recorded during the summer, suggesting there are no significant populations is Nova Scotia (Lucas and Hebda 2011).

Limited knowledge is available on this species; however research suggests that the species prefers trees with dense foliage that are growing along the edges of clearings, be they in a heavily forested area, an open wooded glade, or in an urban centre (e.g. shade trees along urban streets, city parks) They have also been found roosting in more unusual locations such as a woodpecker hole, a grey squirrel nest, under drift wood, spotted clinging to the overhangs of buildings, and in caves during the late summer (Anderson 2002). ACCDC data indicates that the closest observation of this species to the Project site was 61.7 km away.

The majority of the surrounding area is used for landfill activities and has been cleared of vegetation to accommodate landfill infrastructure (i.e., landfill cells, water retaining ponds, maintenance building, waste/refuse storage areas, access roads), making it unlikely that this species is present in the area. No further consideration of effects and mitigation for this species has been undertaken.

A targeted mammal survey was not completed at the Project site; however, during a site visit to the KMEMC property in March, 2014, the only wildlife observed in the area was a red squirrel (*Tamiasciurus hudsonicus*). Approximately 1.7 km northwest of the Project site, field studies conducted in 2012 as part of the Environmental Assessment process for the Kaizer Meadow Wind Turbine Project observed eight species of commonly occurring mammals: American black bear (*Ursus americanus*), American red squirrel (*Tamiasciurus hudsonicus*), Eastern coyote (*Canis latrans*), raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), short-tailed shrew (*Sorex maritimensis*), American mink (*Mustela erminea*) and white-tailed deer (*Odocoileus virginianus*).

5.4.4 Herpetofauna

A search of the Nova Scotia Significant Species and Habitat Database (NSDNR 2016) for species and/or habitat records pertaining to herptofauna within a 100 km radius of the Project site was completed. The database contains 58 records classified as 'Species at Risk', all of which relate to the wood turtle (*Glyptemys insculpta*).

There are no records pertaining to herptofauna within a 10 km radius of the Project site.

The ACCDC database identifies five terrestrial herpetofauna SOCI within a 100 km radius of the Study area (Table 5.10).

Table 5.10: Reptile and Amphibian Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NSESA Status[3]	NS GS-Rank[4]	NS S-Rank[4]
Blanding's Turtle – Nova Scotia pop.	*Emydoidea blandingii*	Endangered	Endangered	Endangered	At Risk	S1
Eastern Ribbon Snake – Atlantic Pop.	*Thamnophis sauritus – pop. 3*	Threatened	Threatened	Threatened	At Risk	S2S3
Four-toed Salamander	*Hemidactylium scutatum*	Not At Risk	Not Listed	Not Listed	Secure	S3
Snapping Turtle	*Chelydra serpentina*	Special Concern	Special Concern	Vulnerable	Sensitive	S3
Wood Turtle	*Glyptemys insculpta*	Threatened	Threatened	Threatened	Sensitive	S2

Source: ACCDC 2018; [1] COSEWIC 2018; [2] GC 2017; [3]NSDNR 2017b; [4]ACCDC 2018

Blanding's turtles make use of a variety of wetland habitats including lakes, ponds, brooks, creeks, and marshes (COSEWIC 2005), and are closely associated with areas of extensive beaver activity (TBTRT 2012). The known range of this species in Nova Scotia is restricted to the southwestern interior of the province where there are five disjunct populations within the Medway, Mersey, and Sissiboo River watersheds (TBTRT 2012). ACCDC data indicate that the closest observation of this species to the Project site was 47.4 km. The geographic separation from the range of Blanding's turtle in Nova Scotia means that it is highly unlikely that species occurs at the Project site. The Project is therefore not expected to have any impact on Blanding's turtle and no further consideration of effects and mitigation for this species has been undertaken.

Eastern ribbon snake is a semi-aquatic species typically found in freshwater habitats including wetlands, still water streams, lakeshores and marshes (COSEWIC 2002). They are rarely found more than 30 m from the water's edge and prefer shallow waters with aquatic vegetation and amphibians (GC 2017). In Nova Scotia, concentrations of Eastern ribbon snake are thought to be limited to the interior portions of the Mersey, Medway, and LaHave River watersheds in the southwestern region of the province, although recent discoveries have expanded the known range of this species to include the Petite Rivière watershed (Gilhen *et al.* 2012). ACCDC data indicate that the closest observation of this species to the Project site was 50.6 km away. The geographic separation from the range of Eastern ribbon snake in Nova Scotia means that it is highly unlikely that

species occurs at the Project site. The Project is therefore not expected to have any impact on Eastern ribbon snake and no further consideration of effects and mitigation for this species has been undertaken.

The four-toed salamander has a limited range in Canada (Desroches and Rodrigue 2004), with Nova Scotia situated near the species northern range limit. Four-toed salamanders live in bogs, boggy streams, and flood plains in woodland areas. Adults prefer hardwood forests, while larvae live in water pools. The species requires both wetland and woodland habitats, so the protection of both is necessary to ensure their survival (NCC 2016). During the summer, the species lives in mossy forests and requires sphagnum bogs for reproduction. During the winter they burrow underground, sometimes in groups and occasionally with other amphibians such as eastern red-backed salamanders (NCC 2016). ACCDC data indicate that the closest observation of this species to the Project site was 29.8 km away. The lack of extensive aquatic and wetland habitat features in the area of the Project site make it unlikely that this species is present. Therefore, it is unlikely that four-toed salamanders will be impacted by Project activities and no further consideration of effects and mitigation for this species has been undertaken.

Snapping turtle, despite its conservation status, is considered relatively common in mainland Nova Scotia (Davis and Browne 1996). Common snapping turtle habitat is usually associated with slow moving water of moderate depth, with a muddy bottom and dense vegetation. Established populations are typically found in ponds, lakes, and river edges (COSEWIC 2008). The species has a widespread distribution across Nova Scotia, with the largest known population in southwestern Nova Scotia (COSEWIC 2008). ACCDC records indicate that the closest observation of this species to the Project site was 26.0 ± 10.0 km away . The lack of extensive aquatic and wetland habitat features in the Project area make it unlikely that this species is present in the Project site area. Therefore, it is unlikely that the snapping turtle will be impacted by Project activities and no further consideration of effects and mitigation for this species has been undertaken.

Wood turtle requires three key habitat components: a watercourse, sandy substrate for nesting, and a forested area for thermal relief during the summer months (MacGregor and Elderkin 2003). Ideal streams have a clear, moderate flow, a hard bottom composed of sand or gravel, and are 7 to 100 feet wide (MacGregor and Elderkin 2003). The species is found throughout the province but seems to be most abundant in central Nova Scotia, including the Salmon River and Shubenacadie River watersheds (MacGregor and Elderkin 2003). ACCDC data indicate that the closest observation of this species to the Project site was 17.4 ± 5.0 km away. The lack of extensive aquatic and wetland habitat features in the Project area make it unlikely that this species is present in the Project site area. Therefore, it is unlikely that wood turtles will be impacted by Project activities and no further consideration of effects and mitigation for this species has been undertaken.

5.4.5 Insects

A search of the Nova Scotia Significant Species and Habitat Database (NSDNR 2016) for species and/or habitat records pertaining to insects within a 100 km radius of the Project site was completed. The database contains one record classified as "Other Habitat", relating to the Hoary Elfin (*Callophrys polios*).

There are no records relating to significant insect species or habitat within 10 km of the Project site. A review of the ACCDC database for recorded observations of insect species within a 100 km radius of the study area was completed. The ACCDC database review indicates that 57 insect SOCI have been recorded within a 100 km radius of the Project site (Table 5.11).

Table 5.11: Insect Species Recorded Within a 100 km Radius of the Project Site

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NSESA Status[3]	NS GS-Rank[4]	NS S-Rank[4]
Skillet Clubtail	*Gomphus ventricosus*	Endangered	Not Listed	Not Listed	May Be At Risk	S1
Monarch	*Danaus plexippus*	Endangered	Special Concern	Endangered	Sensitive	S2B
Yellow-banded Bumblebee	*Bombus terricola*	Special Concern	Not Listed	Vulnerable	Sensitive	S3
Big Sand Tiger Beetle	*Cicindela formosa*	Not Listed	Not Listed	Not Listed	May Be At Risk	S1
Extra-Striped Snaketail	*Ophiogomphus anomalus*	Not Listed	Not Listed	Not Listed	Not Assessed	S1
Quebec Emerald	*Somatochlora brevicincta*	Not Listed	Not Listed	Not Listed	May Be At Risk	S1
Tidewater Mucket	*Leptodea ochracea*	Not Listed	Not Listed	Not Listed	Sensitive	S1
Silvery Checkerspot	*Chlosyne nycteis*	Not Listed	Not Listed	Not Listed	Undetermined	S1?
Eastern Comma	*Polygonia comma*	Not Listed	Not Listed	Not Listed	At Risk	S1?
Satyr Comma	*Polygonia satyrus*	Not Listed	Not Listed	Not Listed	Sensitive	S1?
Grey Hairstreak	*Strymon melinus*	Not Listed	Not Listed	Not Listed	Secure	S1S2
Compton Tortoiseshell	*Nymphalis l-album*	Not Listed	Not Listed	Not Listed	Secure	S1S2
Kennedy's Emerald	*Somatochlora kennedyi*	Not Listed	Not Listed	Not Listed	May Be At Risk	S1S2
Taiga Bluet	*Coenagrion resolutum*	Not Listed	Not Listed	Not Listed	Secure	S1S2
Zebra Clubtail	*Stylurus scudderi*	Not Listed	Not Listed	Not Listed	May Be At Risk	S1S2
Bronze Copper	*Lycaena hyllus*	Not Listed	Not Listed	Not Listed	Secure	S2
Banded Hairstreak	*Satyrium calanus*	Not Listed	Not Listed	Not Listed	Undetermined	S2
Banded Hairstreak	*Satyrium calanus falacer*	Not Listed	Not Listed	Not Listed	At Risk	S2
Arctic Fritillary	*Boloria chariclea*	Not Listed	Not Listed	Not Listed	Sensitive	S2

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NSESA Status[3]	NS GS-Rank[4]	NS S-Rank[4]
Milbert's Tortoiseshell	*Aglais milberti*	Not Listed	Not Listed	Not Listed	Secure	S2
Prince Baskettail	*Epitheca princeps*	Not Listed	Not Listed	Not Listed	Sensitive	S2
Ebony Boghaunter	*Williamsonia fletcheri*	Not Listed	Not Listed	Not Listed	May Be At Risk	S2
Orange Bluet	*Enallagma signatum*	Not Listed	Not Listed	Not Listed	May Be At Risk	S2
Spot-Winged Glider	*Pantala hymenaea*	Not Listed	Not Listed	Not Listed	Sensitive	S2?B
Northern Cloudywing	*Thorybes pylades*	Not Listed	Not Listed	Not Listed	Sensitive	S2S3
Pepper and Salt Skipper	*Amblyscirtes hegon*	Not Listed	Not Listed	Not Listed	Secure	S2S3
Striped Hairstreak	*Satyrium liparops*	Not Listed	Not Listed	Not Listed	Undetermined	S2S3
Striped Hairstreak	*Satyrium liparops strigosum*	Not Listed	Not Listed	Not Listed	Sensitive	S2S3
Baltimore Checkerspot	*Euphydryas phaeton*	Not Listed	Not Listed	Not Listed	Secure	S2S3
Brook Snaketail	*Ophiogomphus aspersus*	Not Listed	Not Listed	Not Listed	May Be At Risk	S2S3
Maine Snaketail	*Ophiogomphus mainensis*	Not Listed	Not Listed	Not Listed	May Be At Risk	S2S3
Rusty Snaketail	*Ophiogomphus mainensis*	Not Listed	Not Listed	Not Listed	May Be At Risk	S2S3
Forcipate Emerald	*Somatochlora forcipata*	Not Listed	Not Listed	Not Listed	May Be At Risk	S2S3
Delicate Emerald	*Somatochlora franklini*	Not Listed	Not Listed	Not Listed	Sensitive	S2S3
Seaside Dragonlet	*Erythrodiplax berenice*	Not Listed	Not Listed	Not Listed	Sensitive	S2S3
Vesper Bluet	*Enallagma vesperum*	Not Listed	Not Listed	Not Listed	Sensitive	S2S3
Parenthesis Lady Beetle	*Hippodamia parenthesis*	Not Listed	Not Listed	Not Listed	Undetermined	S3
a Ladybird beetle	*Naemia seriata*	Not Listed	Not Listed	Not Listed	Sensitive	S3
Twice-stabbed Lady Beetle	*Chilocorus stigma*	Not Listed	Not Listed	Not Listed	Secure	S3
Henry's Elfin	*Callophrys henrici*	Not Listed	Not Listed	Not Listed	Secure	S3
Bog Elfin	*Callophrys lanoraieensis*	Not Listed	Not Listed	Not Listed	May Be At Risk	S3

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NSESA Status[3]	NS GS-Rank[4]	NS S-Rank[4]
Aphrodite Fritillary	*Speyeria aphrodite*	Not Listed	Not Listed	Not Listed	Secure	S3
Green Comma	*Polygonia faunus*	Not Listed	Not Listed	Not Listed	Secure	S3
Little Wood-satyr	*Megisto cymela*	Not Listed	Not Listed	Not Listed	Secure	S3
Jutta Arctic	*Oeneis jutta*	Not Listed	Not Listed	Not Listed	May Be At Risk	S3
Mottled Darner	*Aeshna clepsydra*	Not Listed	Not Listed	Not Listed	Secure	S3
Lance-Tipped Darner	*Aeshna constricta*	Not Listed	Not Listed	Not Listed	Secure	S3
Ocellated Darner	*Boyeria grafiana*	Not Listed	Not Listed	Not Listed	Sensitive	S3
Harlequin Darner	*Gomphaeschna furcillata*	Not Listed	Not Listed	Not Listed	Sensitive	S3
Clamp-Tipped Emerald	*Somatochlora tenebrosa*	Not Listed	Not Listed	Not Listed	Secure	S3
Elfin Skimmer	*Nannothemis bella*	Not Listed	Not Listed	Not Listed	Secure	S3
Vernal Bluet	*Enallagma vernale*	Not Listed	Not Listed	Not Listed	Undetermined	S3
Question Mark	*Polygonia interrogationis*	Not Listed	Not Listed	Not Listed	Secure	S3B
Juvenal's Duskywing	*Erynnis juvenalis*	Not Listed	Not Listed	Not Listed	Secure	S3S4
Common Roadside-Skipper	*Amblyscirtes vialis*	Not Listed	Not Listed	Not Listed	Secure	S3S4
Grey Comma	*Polygonia progne*	Not Listed	Not Listed	Not Listed	Secure	S3S4
Northern Pygmy Clubtail	*Lanthus parvulus*	Not Listed	Not Listed	Not Listed	Secure	S3S4

Source: ACCDC 2018; [1] COSEWIC 2018; [2] GC 2017; [3]NSDNR 2017b; [4]ACCDC 2018

All species listed above in Table 5.11 are considered priority insect species.

The Monarch, Skillet clubtail, and Yellow-banded bumblebee have been granted a designated conservation status at either the provincial or federal level.

The Monarch can be found in open-habitats with abundant wildflower growth. Milkweed (*Asclepias* spp.) is a critical element of breeding habitat, whereas asters (*Asteraciae* spp.) and goldenrods (*Solidago* spp.) provide necessary food resources during migration (MTRI 2008). Nova Scotia falls within the breeding range of this migratory species (COSEWIC 2010c), and individuals can be found throughout the province from May to October (ACCDC 2016). Considering the widespread distribution of the species in Atlantic Canada, it is possible that the Monarch may transit through the

Project site, particularly during the migratory period (late summer/early fall); however, it is unlikely that the Project site provides sufficient nectar resources to support a large congregation of migratory Monarchs.

The Skillet clubtail is a specialist species of dragonfly requiring large, clean, medium to slow running waters with fine sand, clay or silt substrate (COSEWIC 2010d). The presence of this species in a watercourse is considered an indication of a high-quality aquatic habitat because the larvae are highly sensitive to eutrophication due to excessive nutrient input from sewage, sedimentation due to agriculture and forestry runoff, pesticides, herbicides, and chemicals (COSEWIC 2010d). Aside from a population extant in the area of Fredericton, NB, there are currently only two other known Canadian records, both of which are from Nova Scotia; an adult collected in 1948 from Mount Uniacke, and an exuvia collected in 1992 from Shubenacadie River (COSEWIC 2010d). Though the records from NS fall within the 100 km radius of the Project site, the site does not have the highly specialized habitat required by the Skillet clubtail, making the presence of this species within the Project site highly unlikely.

The Yellow-banded bumblebee can be found in various habitats throughout Nova Scotia, including mixed woodlands, agricultural habitats, and urban areas. It is a generalist species, feeding on both pollen and nectar from a wide range of plant genera. These bees usually nest and overwinter (queens) underground, often taking advantage of abandoned rodent burrows and rotting logs (COSEWIC 2015). In 2015, the Yellow-banded bumblebee was listed of 'Special Concern' by COSEWIC and in 2017 it was list as 'Vulnerable' by the NS ESA. Considering this species was once widespread in Nova Scotia, it is possible that it could be present at the Project site; however, it is unlikely that the Project site provides sufficient pollen or nectar resources to meet the dietary requirements of this species as much of it is a landfill site.

5.4.6 Potential Interactions and Effects

The proposed Project is not expected to adversely impact the terrestrial environment during construction, operation, or decommissioning as the Pyrolysis Plant will be constructed and operated from within the Advanced MSW Recycling Demonstration Facility building, which is located at a site with a long history of landfill activities.

5.4.7 Specific Mitigative and Protection Measures

The following mitigative measures will be implemented during construction activities to minimize the potential impacts to terrestrial environment:

- Implementation of the EPP, including the ESCP, spill prevention plan and contingency plans (as necessary) will be implemented prior to construction.

5.4.8 Potential Residual Effects

No residual effects on the terrestrial environment are anticipated.

5.4.9 Recommended Monitoring and Follow-up

Follow-up and monitoring may be recommended should the Monarch, Skillet clubtail, or Yellow-banded bumblebee be found at a later time on the Project site.

5.5 Avifauna

5.5.1 Desktop Review

The Project site is contained within map square 20MQ05 of the Maritime Breeding Bird Atlas (MBBA) (BSC 2016). In the first edition (1986-1990), 72 species were identified as being possible, probable, or confirmed breeders; in the second edition (2006-2010), this increased to 82 species. Two SOCI are considered confirmed breeders within map square 20MQ05 between 2006-2010:

Table 5.12: Confirmed Breeding SOCI within MBBA Map Square 20MQ05 (2006-2010)

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NSESA Status[3]	NS GS-Rank[4]	NS S-Rank[4]
Killdeer	*Charadrius vociferus*	Not Listed	Not Listed	Not Listed	Sensitive	S3B
Gray Jay	*Perisoreus canadensis*	Not Listed	Not Listed	Not Listed	Sensitive	S3

There are no listed Important Bird Areas (IBA) within the vicinity of the proposed Project site. Southern Bight in the Minas Basin is the closest IBA, approximately 26 km north of the project site. It is an important staging ground for an estimated 1 to 2 million shorebirds in late July and early August (in this and other adjacent IBAs). A high diversity of migrant shorebirds forage on the large intertidal mud and sand flats throughout the Bight. Commonly observed species include: red knot *(Calidris canutus)*, sanderling (*Calidris alba)*, short-billed dowitcher *(Limnodromus griseus),* least sandpiper *(Calidris minutilla),* and semipalmated plover *(Charadrius semipalmatus)*. The nearest coastal waters (Mahone Bay) are approximately 17 km south of the Project site; therefore, there are no expected effects to shorebirds from the Project.

The ACCDC database contains records of 117 bird SOCI within a 100 km radius of the Project site. Table G1 (Appendix G) lists these species as well as their respective provincial and national conservation status ranks. While the majority of species listed in Table G1 are considered priority species, only the following 26 have been granted a designated conservation status at either the provincial or national level:

Table 5.13: SOCI with a Provincial and/or National Conservation Status within 100 km of the Project Site.

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NSESA Status[3]	NS GS-Rank[4]	NS S-Rank[4]
Piping Plover melodus ssp	*Charadrius melodus melodus*	Endangered	Endangered	Endangered	At Risk	S1B
Roseate Tern	*Sterna dougallii*	Endangered	Endangered	Endangered	At Risk	S1B
Northern Bobwhite	*Colinus virginianus*	Endangered	Endangered	Not Listed	N/A	N/A
Harlequin Duck - Eastern pop.	*Histrionicus histrionicus pop. 1*	Special Concern	Special Concern	Endangered	At Risk	S2N

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NSESA Status[3]	NS GS-Rank[4]	NS S-Rank[4]
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Special Concern	Endangered	May Be At Risk	S2B
Eastern Wood-Pewee	*Contopus virens*	Special Concern	Special Concern	Vulnerable	Sensitive	S3S4B
Peregrine Falcon - anatum/tundrius	*Falco peregrinus pop. 1*	Special Concern	Special Concern	Vulnerable	Sensitive	S1B, SNAM
Savannah Sparrow princeps ssp	*Passerculus sandwichensis princeps*	Special Concern	Special Concern	Not Listed	Sensitive	S1B
Short-eared Owl	*Asio flammeus*	Special Concern	Special Concern	Not Listed	May Be At Risk	S1S2B
Bicknell's Thrush	*Catharus bicknelli*	Threatened	Special Concern	Endangered	At Risk	S1S2B
Bank Swallow	*Riparia riparia*	Threatened	Threatened	Endangered	May Be At Risk	S2S3B
Barn Swallow	*Hirundo rustica*	Threatened	Threatened	Endangered	At Risk	S2S3B
Canada Warbler	*Wilsonia canadensis*	Threatened	Threatened	Endangered	At Risk	S3B
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened	Endangered	At Risk	S2B, S1M
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	Threatened	At Risk	S2B
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened	Threatened	At Risk	S2B
Whip-Poor-Will	*Caprimulgus vociferus*	Threatened	Threatened	Threatened	At Risk	S1?B
Bobolink	*Dolichonyx oryzivorus*	Threatened	Threatened	Vulnerable	Sensitive	S3S4B
Eastern Meadowlark	*Eastern Meadowlark*	Threatened	Threatened	Not Listed	Sensitive	SHB
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Threatened	Threatened	Not Listed	Accidental	SNA
Wood Thrush	*Hylocichla mustelina*	Threatened	Threatened	Not Listed	Undetermined	SUB
Red Knot rufa ssp	*Calidris canutus rufa*	Endangered	Not Listed	Endangered	At Risk	S2M
Evening Grosbeak	*Coccothraustes vespertinus*	Special Concern	Not Listed	Vulnerable	Secure	S3S4B, S3N
Buff-breasted Sandpiper	*Tryngites subruficollis*	Special Concern	Not Listed	Not Listed	Accidental	SNA
Horned Grebe	*Podiceps auritus*	Special Concern	Not Listed	Not Listed	Secure	S4N

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NSESA Status[3]	NS GS-Rank[4]	NS S-Rank[4]
Red-necked Phalarope	*Phalaropus lobatus*	Special Concern	Not Listed	Not Listed	Sensitive	S2S3M

Source: ACCDC 2018; [1] COSEWIC 2018; [2] GC 2017; [3]NSDNR 2017b; [4]ACCDC 2018

5.5.2 Avifauna Studies

Avifauna surveys were done near the Project site in 2012 as part of the EA for the Kaiser Meadow Wind Turbine. Field surveys were employed to complement desktop information and to characterize the bird community in the area of the Project site throughout the year. These surveys were carried out by an expert birder and were designed to capture changes in the diversity and abundance of bird species at the Project site coinciding with such important events as breeding and migration. All field surveys were designed in consultation with officials from NSDNR and CWS, and conformed to protocols outlined in "Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds" (CWS 2007). Most bird surveys were planned for days when the Kaiser Meadow landfill was closed in order to avoid any potential influence to local avifauna from the noise and general presence of truck traffic associated with landfill activities.

Fall Migration Surveys

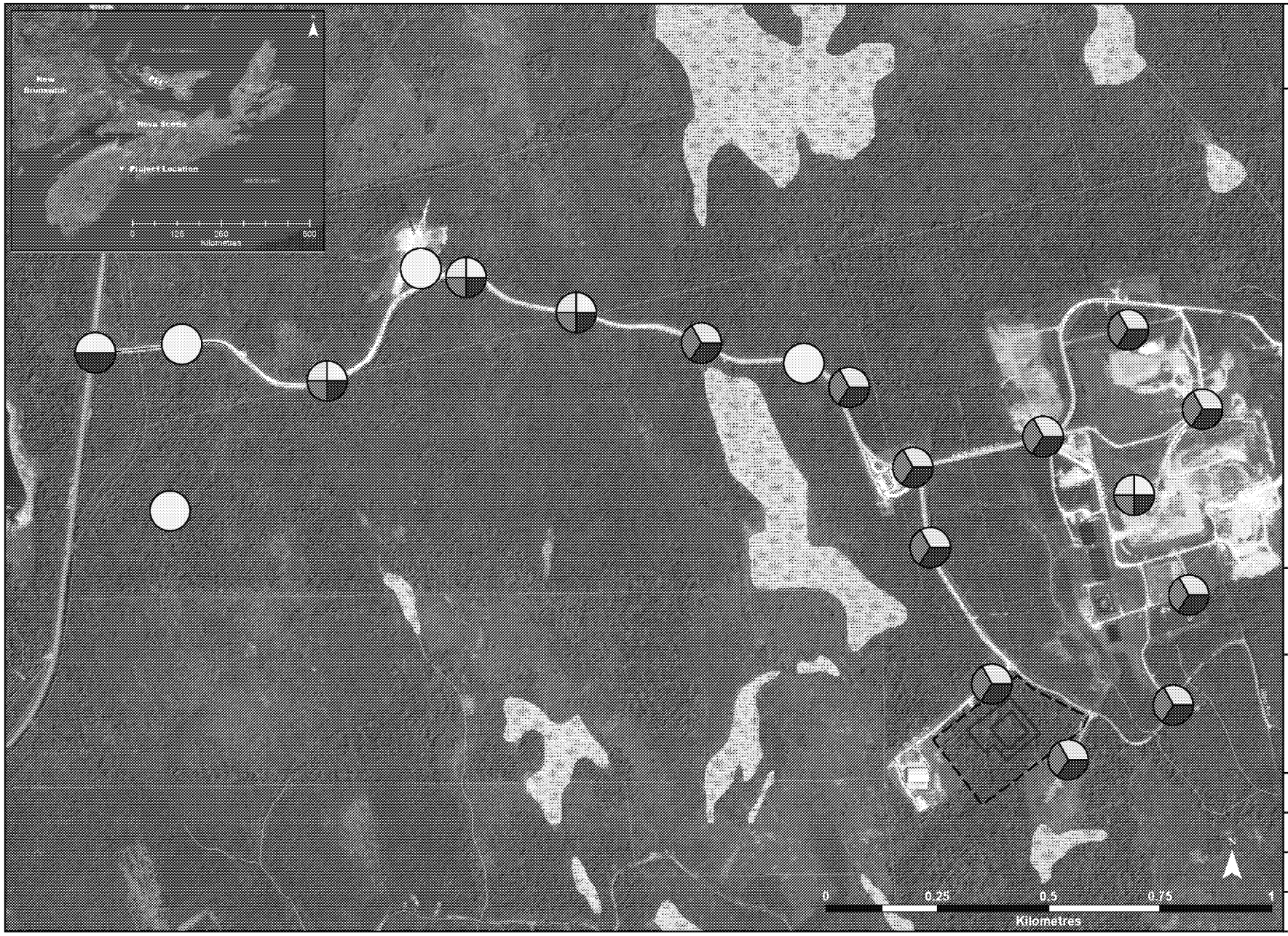
The use of the Project area by migratory birds in the fall season was evaluated using two survey types: stopover counts to assess migrating flocks of passerines and passage migration counts to assess migrating raptors and other diurnal migrants. A summary of survey results are provided in Table G2, (Appendix G). Drawing 5.2 provides locations of all bird survey locations.

Stopover Count Surveys

There were 11 stopover count surveys conducted at or near the Project site on November 6, 2011 (Drawing 5.2). A total of 29 species, including 997 individual birds, were identified during these surveys. American Crow (*Corvus brachyrhynchos*), Red-breasted Nuthatch, Purple Finch (*Carpodacus purpureus*), and Common Raven (*Corvus corax*) were the most frequently observed species, while European Starling (*Sturnus vulgaris*), Herring Gull (*Larus argentatus*), and American Crow were the most abundant species. European Starlings and Herring Gulls were each observed in large numbers on just a single occasion.

The following priority species were observed at or near the Project site during these stopover count surveys:

- Boreal Chickadee – "Sensitive" (NSDNR 2017b);
- Golden-crowned Kinglet – "Sensitive" (NSDNR 2017b);
- Gray Jay –"Sensitive" (NSDNR 2017b);
- Pine Siskin – "Sensitive" (NSDNR 2017b);
- Ruby-crowned Kinglet – "Sensitive" (NSDNR 2017b);
- Rusty Blackbird (*Euphagus carolinus*) – "May be at Risk" (NSDNR 2017b), "Special Concern" (COSEWIC 2018), "Special Concern" (GC 2017); and
- Turkey Vulture (*Cathartes aura*) – "Sensitive" (NSDNR 2017b).



Notes:

1. Data Sources: GeoNOVA, NSTD, Sustane.
2. Basemap: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
3. Projection: NAD83 UTM Zone 20 North.

Legend:

- PID60704418
- Advanced MSW Recycling Building
- Property Boundaries

Transportation

- Local Road
- Unpaved Road
- Driveway
- Track

Water Features

- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area

Bird Survey Locations

- Fall
- Winter
- Spring
- Breeding

Sustane Chester Inc. Pyrolysis Plant - Bird Survey Locations

Strum Environmental

*Engineering * Surveying * Environmental*
*Bedford * Antigonish * Moncton * Deer Lake*

Date: June 2018	Project #: 18-6355
Scale: 1:8,000	Drawing #: 5.2
Drawn By: M. Marriott	
Checked By: S. Dickey	

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Passage Migration Survey
A reduced passage migration survey was conducted at the Project site on November 6, 2011 (Drawing 5.2). The location of this survey was chosen to ensure an unobstructed view of the horizon enabling the identification of all migrating birds. The survey was 10 minutes in duration. Red-tailed Hawk (*Buteo jamaicensis*) was the only species identified during this survey, and the observation consisted of just a single individual.

As such, no priority species were observed at the Project site during the passage migration survey.

Winter Bird Surveys
The resident winter bird community at the Project site was investigated using the area search methodology (CWS 2007). Detailed survey results are provided in Table G2, Appendix G.

There were 15 area searches conducted at or near the Project site on March 25, 2012 (Drawing 5.2). A total of 42 species were identified, including 1,175 individual birds. Common Raven was the most abundant species, although there were more observations of American Crow and Mourning Dove (*Zenaida macroura*). Herring Gulls were also prevalent during the winter bird survey, with 147 individuals observed.

The following priority species were identified at or near the Project site during these winter surveys:
- Boreal Chickadee – "Sensitive" (NSDNR 2017b);
- Golden-crowned Kinglet – "Sensitive" (NSDNR 2017b);
- Gray Jay – "Sensitive" (NSDNR 2017b);
- Killdeer – "Sensitive" (NSDNR 2017b);
- Pine Siskin – "Sensitive" (NSDNR 2017b); and
- Ruby-crowned Kinglet – "Sensitive" (NSDNR 2017b).

Spring Bird Migration Surveys
Spring migration surveys were conducted during site visits on April 29 and May 20, 2012. A total of 29 stopover count surveys were conducted at 15 locations at or near the Project site (Drawing 5.2). Detailed results of the spring migration surveys are provided in Table G2, Appendix G.

A total of 70 bird species, comprising 1,822 individual birds, were observed during the spring migration surveys. American Robin (*Turdus migratorius*) was the most frequently observed and most abundant species, and Common Raven and American Crow were the second and third most abundant species, respectively. Flocks in excess of 10 individuals were observed for American Robin, American Crow, American Goldfinch (*Spinus tristis*), Common Raven, European Starling, Great Black-backed Gull (*Larus marinus*), Herring Gull, Pine Siskin, Common Grackle (*Quiscalus quiscula*), and White-throated Sparrow (*Zonotrichia albicollis*).

The majority of bird species observed were passerines, but shorebird, waterfowl, woodpecker, and upland gamebird species, as well as birds of prey, were also recorded.

The following priority species were identified at the Project Site during these spring migration surveys:

- Boreal Chickadee – "Sensitive" (NSDNR 2017b);
- Canada Warbler (*Wilsonia canadensis*) – "May be at risk" (NSDNR 2017b), "Threatened" (COSEWIC 2018), "Threatened" (GC 2018);
- Eastern Wood-Pewee – "Sensitive" (NSDNR 2017b);
- Golden-crowned Kinglet – "Sensitive" (NSDNR 2017b);
- Gray Jay – "Sensitive" (NSDNR 2017b);
- Killdeer – "Sensitive" (NSDNR 2017b);
- Pine Siskin – "Sensitive" (NSDNR 2017b);
- Ruby-crowned Kinglet – "Sensitive" (NSDNR 2017b);
- Tennessee Warbler (*Vermivora peregrine*) – "Sensitive" (NSDNR 2017b);
- Tree Swallow – "Sensitive" (NSDNR 2017b); and
- Yellow-bellied Flycatcher – "Sensitive" (NSDNR 2017b).

Breeding Bird Surveys

Breeding bird surveys were carried out at or near the Project site in 2011 using the point count methodology (CWS 2007). Survey times and locations were chosen to coincide with the peak of the breeding season and to investigate the breeding bird communities at areas of interest. Detailed survey results are provided in Table G2, Appendix G.

A total of 15 point count locations were surveyed on June 10 and 17, 2012 (Drawing 5.2). A total of 1,863 individual birds, representing 71 species, were observed during 29 point counts. Of these, 30 species are considered probable breeders based upon the observance of breeding pairs and/or the establishment of permanent territories (Table G2, Appendix G), and 41 species were considered possible breeders. The most frequently observed species, in terms of the number of point counts at which they were recorded, were American Robin, Dark-eyed Junco, and Mourning Dove. Common Raven was the most abundant species observed with 343 individuals recorded during the point count surveys, followed by American Robin and American Crow.

The vast majority of the species identified during the breeding bird surveys were passerines. However, a variety of non-passerine birds were also observed during these surveys, including American Black Duck, Canada Goose (*Branta canadensis*), and Common Merganser (*Mergus merganser*) (waterfowl); Bald Eagle and Northern Goshawk (*Accipiter gentilis*) (birds of prey); Downy Woodpecker (*Picoides pubescens*), Hairy Woodpecker (*Picoides villosus*), Northern Flicker (*Colaptes auratus*), and Pileated Woodpecker (*Dryocopus pileatus*) (woodpeckers); Ruffed Grouse (*Bonasa umbellus*) (upland game birds); and Herring Gull, Great Black-backed Gull, Ring-billed Gull (*Larus delawarensis*) and Killdeer (shorebirds).

The following priority species were identified at or near the Project Site during the breeding bird surveys:

- Boreal Chickadee – "Sensitive" (NSDNR 2017b);
- Canada Warbler – "May be at risk" (NSDNR 2017b), "Threatened" (COSEWIC 2018), "Threatened" (GC 2018);
- Eastern Wood-Pewee – "Sensitive" (NSDNR 2017b);

- Golden-crowned Kinglet – "Sensitive" (NSDNR 2017b);
- Gray Catbird – "May be at risk" (NSDNR 2017b);
- Gray Jay – "Sensitive" (NSDNR 2017b);
- Killdeer – "Sensitive" (NSDNR 2017b);
- Pine Siskin – "Sensitive" (NSDNR 2017b);
- Ruby-crowned Kinglet – "Sensitive" (NSDNR 2017b);
- Spotted Sandpiper – "Sensitive" (NSDNR 2017b);
- Tennessee Warbler – "Sensitive" (NSDNR 2017b);
- Tree Swallow – "Sensitive" (NSDNR 2017b); and
- Yellow-bellied Flycatcher – "Sensitive" (NSDNR 2017b).

Summary of Bird Surveys
The bird community in the vicinity of the Project site is strongly influenced by the proximity to the landfill associated with the KMEMC. This feature is exploited as a food resource by a variety of scavenging species such as American Crow, Common Raven, and Herring Gull, and appears to attract a large number of these bird species in all seasons. The presence of the landfill also explains the large number of birds present near the Project site in the winter, when abundances are typically lower than in other seasons. In addition, water treatment ponds at this facility provide habitat for waterfowl species including American Black Duck and Mallard. The Project site itself lacks open bodies of water so it is unlikely that waterfowl use the site directly.

It is expected that shorebirds and waterfowl may move between the landfill and water treatment ponds of the KMEMC and several lakes located to the west of Highway 14, including Card Lake. Most notably, it is likely that large groups of gull species (i.e. Herring Gull) use this local flight path, which passes over the Project site.

There were 81 species identified at or near the Project site during surveys conducted throughout the year, including thrushes, sparrows, warblers, birds of prey, and other passerine and non-passerine species. In addition, 15 priority species were identified, suggesting that the general area may be composed of areas of useful to important bird habitat.

5.5.3 Potential Interactions and Effects
The proposed Project may impact avifauna during construction, operation and decommissioning. Potential impacts include:

- Potential mortality from interactions with the flare stacks.
- Potential effects from accidental events/spills during installation, maintenance, or decommissioning.

5.5.4 Specific Mitigative and Protection Measures
The following mitigative measures will be implemented to avoid and mitigate any potential effects on avifauna:

- Curtailing the flare in low visibility conditions (e.g. at night and during foggy conditions) during spring and fall migratory periods.
- Conducting a post-construction monitoring program to monitor for bird mortalities during sensitive periods (e.g. after low visibility conditions during the fall migration period).

5.5.5 Potential Residual Effects

An analysis of the residual effects on the avifauna is provided in Table 5.14.

Table 5.14: Determination of Residual Effects to the Avifauna

VEC	Potential Effect	Significance Criteria	Residual Effects	Significance of Residual Effects
Avifauna	Interaction with flare stacks	Scope: Local Duration: Long-term Frequency: Intermittent Magnitude: Low	Medium	None
	Sensory disturbance	Scope: Local Duration: Long term Frequency: Continuous Magnitude: Low	Low	None
	Direct mortality	Scope: Local Duration: Long -term Frequency: Intermittent Magnitude: Low	Low	None

5.5.6 Recommended Monitoring and Follow-up

An avian management plan will be developed and incorporated into the EPP. This plan will include a protocol for identifying periods when the flare stack should be curtailed, as well as for post-construction bird mortality monitoring.

6.0 SOCIO-ECONOMIC ENVIRONMENT

6.1 Local Demographics

The Project site is located in Lunenburg County in the Municipality of the District of Chester (MODC). The area around the Project site is sparsely populated by the small communities of Canaan, (approximately 4.5 km to the south), Sherwood (approximately 4.9 km to the southwest), New Ross (approximately 17.4 km to the southwest), Chester (approximately 19.6 km to the south), and Upper Vaughan (approximately 9.3 km to the north). The largest towns in Lunenburg County include Bridgewater (population 8,532), Lunenburg (population 2,085), Chester (population 1,458) and Mahone Bay (population 1,036) (Statistics Canada 2017).

6.1.1 Demography

Population statistics from the 2016 census are summarized in Table 6.1.

Table 6.1: Population Statistics for Lunenburg County and Municipality of the District of Chester

Population Statistics	Lunenburg County	MODC
Population in 2016	47,126	10,310
Population in 2011	47,313	10,599
Population change from 2016-2011 (%)	-0.4	-2.7
Total private dwellings in 2016	26,648	6,492
Land area (square km)	2,909.77	1,122.11
Population density per square kilometer	16.2	9.2

Source: Statistics Canada 2017

The age distribution in Lunenburg County and the MODC reveals median ages of 52.0 and 53.1 years, respectively. These ages are slightly higher than the provincial median age of 45.5 years (Statistics Canada 2017). An overview of age distribution for 2016 in these two areas is outlined in Table 6.2 below.

Table 6.2: Age Distribution in Lunenburg County and Municipality of the District of Chester

Age Statistics	Lunenburg County	MODC
0 - 14 years	5,805 (12%)	1,265 (12%)
15 - 64 years	29,070 (62%)	6,265 (61%)
65+ years	12,255 (26%)	2,780 (27%)

Source: Statistics Canada 2017

In 2015, the average income for individuals in Lunenburg County and the MODC were $28,516 and $28,795 per year, respectively; compared with the provincial average of $31,813/year (Statistics Canada 2013). These averages are only slightly lower than the Canadian average individual income of $34,204/year (Table 6.3).

The average value of dwellings in Lunenburg County and the MODC in 2016 was $235,451 and $278,446, both of which were higher than the average province value of $230,441 (Table 6.3).

Table 6.3: Average Housing Value and Median Total Individual Income (2015)

Jurisdictions	Average Housing Value	Median Total Individual Income
Lunenburg County	$235,451	$28,516
Municipality of the District of Chester	$278,446	$28,795
Province of Nova Scotia	$230,441	$31,813

Source: Statistics Canada 2017

6.1.2 Health Care and Emergency Services

The Town of Windsor (approximately 31.2 km from the Project site) and the nearby community of Vaughan have fire halls on Highway 14, and the Municipality of the District of Chester has seven

volunteer fire departments. The volunteer fire departments offer fire, medical, first response, motor vehicle collision, and water rescue services (MODC 2011). High-angle rescue services are offered by fire departments in HRM and Kentville. The nearest hospital is the Hants Community Hospital in Windsor (~37 km); however, the Fisherman's Memorial Hospital in Lunenburg (~53 km), the South Shore Regional Hospital in Bridgewater (~56 km), and the Valley Regional Hospital in Kentville (~75 km) are also accessible from Project site.

6.1.3 Industry and Employment

Statistics for Lunenburg County and MODC indicate that the unemployment rate in 2016 was 9.1% and 10.2%, respectively; the provincial average was 10.0%. Nova Scotia had an employment rate of 55.2% in 2016, which was slightly higher than the rates in both Lunenburg County (50.7%) and MODC (49.9%) (Statistics Canada 2016).

A breakdown of the labour force within Lunenburg County and MODC is provided in Table 6.4. The highest proportions of workers in Lunenburg County fall into the "manufacturing" category (13.8%), while the highest proportions of workers in MODC are in the "health care and social assistance" category (11.1%). Other significant industries include construction, retail trade, and accommodation and food services (Statistics Canada 2016).

Table 6.4: Labour Force by Industry in Lunenburg County and the Municipality of the District of Chester

Industry	Lunenburg County	MODC
Total Employed labour force 15 years +	22,610	4,955
Manufacturing	3,115 (13.8%)	515 (10.4%)
Health care and social assistance	3,035 (13.4%)	550 (11.1%)
Retail trade	2,875 (12.7%)	475 (9.6%)
Construction	1,835 (8.1%)	530 (10.7%)
Accommodation and food services	1,545 (6.8%)	350 (7.1%)
Educational services	1,380 (6.1%)	295 (6.0%)
Agriculture, forestry, fishing and hunting	1,225 (5.4%)	310 (6.3%)
Administrative and support, waste management and remediation services	1,130 (5.0%)	220 (4.4%)
Public administration	1,115 (4.9%)	270 (5.4%)
Other services (except public administration)	1,110 (4.9%)	285 (5.8%)
Professional, scientific and technical services	980 (4.3%)	280 (5.7%)
Transportation and warehousing	565 (2.5%)	145 (2.9%)
Finance and insurance	490 (2.2%)	125 (2.5%)
Wholesale trade	480 (2.1%)	155 (3.1%)
Arts, entertainment and recreation	480 (2.1%)	155 (3.1%)
Information and cultural industries	390 (1.7%)	110 (2.2%)

Industry	Lunenburg County	MODC
Real estate and rental and leasing	265 (1.2%)	55 (1.1%)
Mining, quarrying, and oil and gas extraction	105 (0.5%)	35 (0.7%)
Utilities	105 (0.5%)	40 (0.8%)
Management of companies and enterprises	0	10 (0.2%)

Source: Statistics Canada 2017

A review of businesses located within close proximity to the Project site is provided in Table 6.5.

Table 6.5: Local Businesses and Proximity to the Project Site

Business	Distance and direction to Project Site*
Kaizer Meadow Environmental Management Centre	<1 km north on Kaizer Meadow Road
Levy's Tree Farm	4.9 km west on Sherwood Road
Sherwood Golf & Country Club	6.3 km west on Sherwood Road
Lakeside Variety Store Irving	13.7 km north on Highway 14
South Shore Concrete Products	13.3 km south on Highway 14

*All distances measured from the Project site using the most direct route.

6.1.4 Potential Interactions and Effects

No effects on local population and demographics are expected as a result of Project activities; therefore this component is not addressed further through mitigation, monitoring or follow-up programs.

6.1.5 Specific Mitigative and Protection Measures

No effects to the local/regional economy from the Project are anticipated; therefore, no mitigation is recommended.

6.1.6 Potential Residual Effects

Residual effects on local economy as a result of Project activities are expected to be positive in nature, and include a significant reduction in plastics ending up in landfills and the environment.

6.1.7 Recommended Monitoring and Follow Up

Ongoing communication with the community will be maintained throughout the Project life.

6.2 Land Use and Value

The project is proposed within the Kaizer Meadow Industrial Zone, at the existing KMEMC. Within a 2 km radius of the Project site, there are 12 buildings, all of which are part of the KMEMC.

6.2.1 Potential Interactions and Effects

No effects on land use and value are expected as a result of Project activities; therefore this component is not addressed further through mitigation, monitoring or follow-up programs.

6.2.2 Specific Mitigative and Protection Measures
As no effects on land use and value are expected from the Project, no mitigation is recommended.

6.2.3 Potential Residual Effects
Residual effects on land use and value as a result of Project activities are expected to be positive in nature, and include a significant reduction in plastics ending up in landfills and the environment.

6.2.4 Recommended Monitoring and Follow Up
Ongoing communication with the community will be maintained throughout the Project life.

6.3 Recreation and Tourism

Existing outdoor recreation in the area includes hunting, fishing (i.e. trout fishing in Card Lake), snowmobiling, ATV use, and hiking and boating (non-motorized) along trails and waterways near Card Lake Provincial Park (SSC 2017). There are wildlife associations serving the area, notably the Hants West Wildlife Association in Hantsport, the Lunenburg County Wildlife Association, the Lunenburg Rod and Gun Club, and the Big Game Society of Nova Scotia in Windsor (Nova Scotia Federation of Anglers and Hunters 2018). For hiking, New Ross offers the New Ross Community Trail and the New Ross Lions Park near Ross Farm Museum on Highway #12 (SSC 2017). The area is also home to the Shore Riders ATV Club in Chester Basin and the Hants Sno-Dusters snowmobiler club in Falmouth (Shore Riders ATV Club 2018; Hants Sno-Dusters 2018).

The 2015 Nova Scotia Visitor Exit Survey Community Report outlines the total trips (stopped or stayed) to communities and tourist regions, as well as capture rates of communities within tourist regions (Tourism Nova Scotia 2016). Table 6.6 shows the total trips (stopped or stayed) that were made to South Shore communities as well as the capture rate (percentage of parties that stopped in a community (short stay or overnight) out of the total number of parties who visited the tourism region).

Table 6.6: South Shore Communities Visited in Nova Scotia (2015)

Region/Community	Total Trips (% who stopped or stayed)	Capture Rate (%)
South Shore	29%	
Bridgewater	5%	18%
Caledonia	0%	1%
Chester	6%	21%
Hubbards	1%	2%
Kejimkujik Seaside Adjunct	0%	2%
LeHave	2%	7%
Liverpool	3%	9%
Lunenburg	16%	55%
Mahone Bay	10%	35%
New Germany	1%	2%
New Ross	1%	2%
Peggy's Cove	16%	54%
Shelburne	2%	8%

Source: Tourism Nova Scotia 2016

The data shows that communities such as Mahone Bay, Lunenburg, and Peggy's Cove were popular tourism destinations (10%, 16% and 16%, respectively), while the remaining South Shore communities captured in the exit survey were not (0-6% visitation). While visiting the area closest to the Project site, the primary tourism activity appears to be cottage vacationing and lake activities.

6.3.1 Potential Interaction and Effects

The popular tourist communities of Mahone Bay, Lunenburg and Peggy's Cove are not located close enough to the Project site (minimum distance of 33 km away) to have tourism sectors negatively affected by the Project. No further assessment required.

6.3.2 Specific Mitigative and Protection Measures

No effects on recreation and tourism are expected as a result of Project activities; therefore this component is not addressed further through mitigation, monitoring or follow-up programs.

6.3.3 Potential Residual Effects

As no effects on recreation and tourism are expected from the Project, no mitigation is recommended.

6.3.4 Recommended Monitoring and Follow Up

Ongoing communication with the community and local tourism organizations will be maintained throughout the Project life.

7.0 CULTURAL AND HERITAGE RESOURCES

The Department of Communities, Culture, and Heritage conducted a review of heritage resources in the vicinity of both the Kaizer Meadow Wind Farm and the KMEMC. No recorded archaeological sites were found in the area and it was determined that potential for pre-contact First Nations archaeological sites was low for this site. Furthermore, historical maps show no settlement related features, suggesting that the potential for historic period archaeological sites is low.

An additional review of a study of archaeological and heritage resources, completed in 2004 for the development of the Kaizer Meadow Landfill, also indicated that there was no record of archaeological sites within or adjacent to that project site (KML Consulting and Jacques Whitford 2004). The 2004 study also stated that the closest area considered to be high potential was Panuke Lake, located 7 km east of the landfill site, and that no archaeological or heritage resources were discovered during construction of the landfill.

Based on the desktop study and review of other information, and the fact that the footprint of the Project is entirely contained within an existing building, it has been determined that an Archaeological Resources Impact Assessment was unnecessary for the Sustane Pyrolysis Project. Culture and heritage resources are therefore not assessed further in the EA.

8.0 MI'KMAQ ECOLOGICAL KNOWLEDGE STUDY

As discussed in section 7.0 above, a review of the cultural and heritage resources studies conducted previously for the Kaizer Meadow Wind farm and the KMEMC found that the likelihood of pre-contact First Nations archaeological sites occurring at the Project site is low. Additionally, the Project footprint is contained entirely within an existing building. As such, a Mi'kmaq Ecological Knowledge Study (MEKS) was deemed to be unnecessary.

9.0 SUMMARY OF EFFECTS ASSESSMENT

Table 9.1 summarizes the results of the effects assessment.

Table 9.1: Summary of Effects Assessments

Project Interaction and Phase	Mitigation Measures	Significant Residual Effect
Atmospheric Environment		
Airborne particulates and dust (construction)	Development and implementation of an EPP for the Project, which will include provisions for erosion and sediment control, emission controls, and dust control; Where required, dust will be controlled by using water or a suitable, approved dust suppressant; and Reduce activities that generate large quantities of dust during high winds.	None
Increased noise levels (construction and operation)	Construction equipment will be maintained in good working order and properly muffled; and Noise-generating construction activities will comply with the requirements of existing by-laws (where applicable).	None
Air Emissions (operation)	Development and implementation of an Air Emissions Management Plan and Air Emissions Monitoring Plan for the Project for incorporation into the EPP	None
Geologic Environment		
Accidental release of deleterious substances	A spill contingency plan will be developed and included in the Project EPP.	None
Freshwater Environment		
No effects on local population and demographics are expected.		
Terrestrial Environment		
No effects on local population and demographics are expected.		
Avifauna		
Sensory disturbance and direct mortality (Construction, Operation)	Clearing (if required) will be conducted outside of the breeding season for most bird species (May 1 to August 31), unless otherwise approved by NSE in consultation with CWS. Should clearing be required during nesting periods, searches for migratory bird nests should be undertaken within the area to be disturbed, in consultation with CWS, and all identified nests should be flagged;	Minimal/None

Project Interaction and Phase	Mitigation Measures	Significant Residual Effect
	Minimize the risk of impacting active nest or birds by measures such as the establishment of vegetated buffer zones around nests, and minimization of activities in the immediate area until nesting is complete and chicks have naturally migrated from the area; and	
Direct mortality (Operation)	Development of an Avian Management Plan to mitigate the potential for the flare stack to cause avian mortalities.	Minimal/None
Local Demographics		
No effects on local population and demographics are expected.		
Land Use and Value		
No effects on local population and demographics are expected.		
Recreation and Tourism		
No effects on local population and demographics are expected.		

10.0 CONSULTATION AND ENGAGEMENT

10.1 Public/Stakeholder Consultation

Sustane commenced the consultation process with the Chester Municipality in 2015 with a number of presentations to the council to discuss the potential project. In these sessions, impacts on the landfill, employment, economics and other topics were covered.

As a part of the municipal process, a public meeting was held on February 24, 2015 to describe the potential project and collect public input. Attendance was approximately 25 individuals and the session was very positive with many questions and no dissenting opinions on the proposed facility.

A description of public consultation as provided by Sustane is available in Appendix H. This description includes a memorandum from the MODC Chief Administrative Officer summarizing the extent of the public consultation and providing the MODC's support for the Project

Subsequent to this session, a series of flyers and newsletters with updates on the project were distributed to residents.

Website

A website for the Project has been developed can be accessed at: http://www.sustanetech.com/. The website provides an overview of the Project, economic benefits, and team member biographies.

10.2 Aboriginal Engagement

The nearest First Nation Community to the Project site is the Glooscap First Nation (approximately 48 km to the northwest). Glooscap First Nation, known as Pesikitk', is a Mi'kmaq aboriginal community located along Smith Road, approximately 6.4 km from the town of Hantsport.

Aboriginal groups which may be impacted by the Project were sent letters outlining the proposed Project in June of 2018:

- Glooscap First Nation;
- Acadia First Nation Gold River Reserve;
- Kwilmu'kw Maw-Klusuaqn Negotiation Office (KMKNO);
- Nova Scotia Office of Aboriginal Affairs.

Copies of these letters are available in Appendix H.

10.3 Review of Public Concerns

Sustane has received strong community support for this project and continues to receive endorsement for the project.

11.0 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

Environmental factors that have the potential to have damaging effects on Project infrastructure include:

- Extreme wind;
- Extreme air temperature and relative humidity
- Fog;
- Ice formation;
- Lightning strikes;
- Fire.

The primary mitigative measure employed during the construction and operation of the Project will be to educate and train site personnel. Environmental and safety orientations will be conducted prior to final commissioning of the Project and all staff will be informed of the potential effects of the environment on the Project. Staff responsible for the operation and maintenance of the Project will be trained on the design and operation of the system, including applicable operating procedures, safety protocols, weather restrictions, and evacuation plans.

Table 11.1 outlines potential effects resulting from environmental events and the mitigation associated with each.

Table 11.1: Effects of Environmental Events and Associated Mitigation

Event	Environmental Effect	Mitigation
Extreme wind	Extreme can alter dispersion of air emissions.	• Curtailment of the flare.
Extreme air temperatures & relative humidity	Higher humidity and air temperatures lower density of air, altering dispersion of air emissions.	• Curtailment of the flare.
Lightning strike	Potential fire during operation and damage to electrical systems.	• Appropriate safety protocol; • Fire prevention plan; • Evacuation plan; and • Local training of first responders.

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Event	Environmental Effect	Mitigation
Fire	Damage to damage to facilities or equipment, and/or forest fire.	• Appropriate safety protocol; • Fire prevention plan; • Evacuation plan; and • Local training of first responders.

12.0 CUMULATIVE EFFECTS ASSESSMENT

Concerns are often raised about the long-term changes that may occur not only as a result of a single action but of the combined effects of each successive action on the environment (Hegman *et al.* 1999).

Cumulative effects have been assessed for the Project by taking into consideration the potential residual effects identified in Section 9, as well as potential effects associated with activities that have taken place in the past, those that currently exist, and those that will imminently take place in the surrounding area.

12.1 Activities Near the Project

The Project is located within a rural setting in Nova Scotia with limited commercial/industrial development in close proximity to the Project site. The nearest towns are Chester (20 km) and Windsor (30 km). The Kaizer Meadow Environmental Management Centre is located <1 km from the Project site. Nearby commercial development consists of forestry operations, a general store, a gas station, a small scale quarry, a golf course, and two wind farms.

Activities that could potentially interact cumulatively with the Project are evaluated in Table 12.1.

Table 12.1: Potential Interactions with the Project

Activity	Status of Activity	Location of Activity	Potential Cumulative Effect on Avifauna/Bats	Significance of Cumulative Effect	Residual Cumulative Effect
South Canoe Wind Farm	Ongoing	A 34 turbine wind farm located on a 2,790 ha of land approximately 6 km west of the Project site boundary.	Avifauna mortality and habitat fragmentation.	Low	No
Kaizer Meadow Wind Farm	Ongoing	A 1 turbine wind farm located, approximately 1.5 km west of the nearest Project site boundary.	Avifauna mortality and habitat fragmentation.	Low	No
Forestry/tree harvesting	Historical and ongoing	Approximately 4.7 km west of the nearest Project site boundary.	Habitat fragmentation.	Low	No

Activity	Status of Activity	Location of Activity	Potential Cumulative Effect on Avifauna/Bats	Significance of Cumulative Effect	Residual Cumulative Effect
Quarry	Historical and ongoing	Small scale quarry approximately 3 km southwest of the Project footprint.	Habitat fragmentation.	Low	No

12.2 Significance of Cumulative Effects

The cumulative effect of the Project and nearby developments may result in impacts to wildlife via habitat fragmentation and increased avifauna mortality. However the significance of these cumulative effects expected to be low. The implementation of an avian management plan (see Section 5.5.6) would mitigate the potential for increased avian mortalities. Additionally, the Project is contained within an existing building so its contribution to habitat fragmentation in the area is very low. As such this assessment did not identify any significant residual cumulative effects.

13.0 CONCLUSION

In accordance with "A Proponent's Guide to Environmental Assessment" (NSE 2014), the studies, regulatory assessments, and VEC evaluations described within this document have been considered both singularly and cumulatively.

The results indicate that there are no significant environmental concerns or impacts that may result from the Project that cannot be effectively mitigated or monitored. Best practices and standard mitigation methods will be implemented during all phases of the Project, to ensure methods and practices are comprehensive and are adhered to. Furthermore, an EPP will be developed and communicated to all employees working on the Project.

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